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THE

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(J. A. BERLY'S).

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THE MANAGEMENT OF BOILERS AND STEAM PLANT.

IN another p'ace we commence a paper by Mr. A. B. Mountain, of Huddersfield, which was read before the Manchester meeting of the Northern Society of Engineers. Like most electrical station engineers, Mr. Mountain is chiefly exercised in the matter of boilers, and the type of boiler to be employed therefore comes in for his consideration. Like many engineers, too, Mr. Mountain appears to have great faith in water-tube boilers, though he may be described as a compound man, for he would start a station with water-tube boilers, and add Lancashire type boilers as the station grew in size. The water-tube boiler, however, falls rapidly in its performance when dirty, and the Lancashire boiler, with economiser, is, in this respect, better, because the economiser separates out so much of the dirt or scale forming salts. Mr. Mountain does not say how he has made up Table I., whether from his own observation, or from borrowed sources; but our readers will be disposed to attach very little weight to the arguments it is meant to convey if they judge everything by one very glaring claim. Mr. Mountain is speaking, be it remembered, of steam pressures not less than 120 lbs. per square inch.

He also claims that the water-tube boiler has the same temperature all over. No part of a water-tube boiler at 120 lbs. will, therefore, be cooler than 350°. Yet Mr. Mountain claims that the waste gases from a water-tube boiler evaporating from 650 to 900 gallons per hour, and occupying only 180 square feet of floor space, pass away from that boiler at 350°. The gases are, in fact, as cold as the boiler. This is a claim we have had frequently to combat. It is regularly made by advocates of water-tube boilers, who should realise either its utter impossibility or see that if occurring the air leakage into the flues must be very great.

The 250° claimed for the economiser is also much too low. It is not, of course, impossible, but it is not met with in regular practice, especially with an economiser of only 72 pipes per boiler, as the figures imply. There is a surprising unanimity about the 600° waste heat of the other boilers in the table, which seems to indicate a merely academic valuation. We observe, however, that while the economiser heating surface in the table appears to be that proper to about 72 tubes, yet in the body of the paper the 250° is assumed to be obtained by the employment of 288 tubes, a number usually considered sufficient for three full-sized Lancashire boilers. The customary figures for economiser calculations are, we may add, for the better understanding of the figures, a capacity of 6 gallons of water per pipe, and one pipe per 3 I.H.P., or if the coal consumption be known, four pipes per ton of coal per week. The heating surface is about 10 feet per pipe. About eight pipes go to the ton weight, and the average temperature reduction is from 650° to 350°, the accession of temperature to the fall being about 150°, equal to an economy

of about 13 per cent., apart from the saving in wear and tear of boilers, and in steadiness of steam pressure. We quite agree with the author, however, in advocating a forced draught and a low chimney temperature, but we do not see where the economy of forced draught comes in, where the chimney temperature still remains high.

We do not understand, moreover, how it is that he can claim such good results from water-tube boilers when he has so clear an idea of their action upon flame, which he says rightly, is extinguished by the tubes. Again, the author makes some good remarks on stoking, but a deplorable error in his reference to the steam jet adding to the heat by its conversion into water gas as it passes through the fire. Moisture in a furnace may assist combustion, for it seems to be proved that its presence is necessary to combustion, its functions being of the nature of a carrier. Steam is burnt hydrogen, and cannot be burned again unless first dissociated by the employment of exactly as much heat as it gives back again on recombination, and the behaviour of steam in a furnace ought to be known to be at most secondary and not primary. As well attempt to obtain steam from old pots, clinkers, and fully carbonised ashes at a vestry depôt, as to burn steam over again. Only engineers who are smart enough to manufacture work for themselves would ever set up a destructor to drive a large power without full provision for the use of other fuel.

We do not quite see the author's argument as to the necessity of large steam valves to prevent priming. The steam valve should be as small as the capacity of the boiler makes it possible to be, but there should be an anti-priming pipe of proper size which will prevent any influence of either a large or small steam valve getting back to the boiler. It appears as though Mr. Mountain did not use these necessary safeguards against priming. Nor is he clear in his remarks upon steam pipe drainage.

They will not apply in respect of drainage back to the boiler unless the steam pipes themselves are above the boilers, when, of course, pipes may be drained directly back. But the method apparently indicated by the author is not possible as he states it. The remainder of the paper calls for little comment.

The Advantages and Disadvantages of the Copper Voltameter.

There are two papers by F. Foerster in the *Zeitschrift fur Elektrochemie* (*vide* No. 3, pages 479—482, and 493—497), in which the copper voltameter is discussed, and its advantages and disadvantages compared. Perhaps the chief advantage of this little apparatus is its handiness, and perhaps on this account it is so largely used, but results obtained with it are not always accepted, for when used with small currents they are known to be rather uncertain. At the same time, it is clear that this voltameter can be used for accurate work, and the reasons why are discussed by Foerster in his paper. The data upon which his arguments are based having been obtained during the investigation which he recently carried out in conjunction with O. Seidel. In the electrolysis of copper sulphate solutions between copper electrodes, the simple transference of copper from the anode to the cathode is not always the only process which goes on. Copper forms two sets of salts, and, during the reactions which go on, cuprous salts may be formed. Hitherto, the existence of a cuprous sulphate has not been admitted. The authors have not succeeded in obtaining it in the solid form, but they have no doubt that it can exist in solutions of cupric sulphate, even if only in a dilute state. It is formed at the cathode, especially when the current density is less than 0·01 ampere per square decimetre. The tendency of cupric ions to become transformed into cuprous ions increases with temperature, so that at 100°, even with a current density of 0·03 ampere per square decimetre, in concentrated copper sulphate solution the current forms almost exclusively cuprous ions at the cathode. As was long ago shown by Jacobi, these ions can even be formed without any current, by the action of copper on cuprous ions (*e.g.*, in the case of cupric chloride); thus:

$$Cu + \overset{++}{Cu} = 2\,\overset{+}{Cu}.$$

In neutral solutions the cuprous sulphate formed, as soon as its concentration reaches a certain value, suffers by hydrolysis; thus:

$$2\,\overset{+}{Cu} + \overset{--}{SO_4} + H_2O = Cu_2O + 2\,\overset{+}{H} + \overset{--}{SO_4}.$$

Cuprous oxide is deposited on the cathode (often in brilliant crystals), and the solution becomes acid. If the solution is acid enough, the hydrolysis does not take place, and more cuprous ions remain than in neutral solution. But as soon as the proportion of these to cupric ions reaches a certain value, they interchange, with deposition of metallic copper:

$$2\,\overset{+}{Cu} = \overset{++}{Cu} + Cu.$$

This should be regarded as secondary copper. It forms separate crystals, not like the usual smooth deposit from acid solutions. One of the most important points in the use of the copper voltameter, is the composition of the electrolyte. This is generally concentrated, and rightly so; a weak solution is apt to give a pulverulent deposit of copper on the cathode. With regard to the presence and effects of cuprous ions, it must be pointed out that the voltameter is used in presence of air, and on exposure to air, the cuprous ions are oxidised to cupric ions. If the solution is acid, copper sulphate is formed:—

$$2\,\overset{+}{Cu} + 2\,\overset{+}{H} + 2\,\overset{--}{SO_4} + O = 2\,\overset{++}{Cu} + 2\,SO_4 + H_2O.$$

If it is neutral, basis copper sulphate is formed:—

$$2\,\overset{+}{Cu} + 2\,\overset{+}{H} + 2\,\overset{-}{OH} + O + \overset{--}{SO_4} = H_2O + Cu(OH_2), Cu\,SO_4.$$

In his second paper the author discusses the errors of the copper voltameter, and how they can best be avoided. It has one unavoidable defect, viz., the low electro-chemical equivalent of copper. But when the composition of the electrolyte and the density of the current are suitably chosen, the instrument is a more accurate one than is usually supposed. It is handier and simpler than the silver or mercury voltameter, and will remain the favourite instrument for technical work. For general use, an electrolyte containing 125 grammes of crystallised copper sulphate and 50 grammes of pure sulphuric acid (sp. gr. 1·84) per litre is recommended. When small currents and low current densities have to be used, it is well to add alcohol, as recommended by Oettel, who always uses an electrolyte made up of a litre of water, 150 grammes of copper sulphate, 50 grammes of sulphuric acid, and 50 grammes of alcohol. By proper adjustment of the current density, currents ranging from 0·01 ampere down to 0·005 ampere can be measured with sufficient accuracy. The cathodes are made of coppe wires being 1 mm. in thickness and flattened out at the ends. But for very small currents the author prefers to use a closed voltameter in which the electrolyte and the electrodes are kept from contact with the air. In this case, no alcohol whatever is added to the electrolyte, but hydrogen is allowed to bubble through it before and during the electrolysis. In order to prevent any undue variations of current density, a number of cathodes of varying sizes should always be kept ready, the smallest being made by flattening out the ends of platinum wires 0·5 mm. thick. When very large currents are measured, it is just as well not to allow the current density to exceed 2 amperes per square decimetre. Above this the copper is apt to be deposited on the cathode in a loose powdery form.

HOW SHOULD BATTERY CELLS BE TESTED?

By RANKIN KENNEDY.

This important question is easily answered, but the next one we propose to deal with is not quite so easy to solve; however, we will endeavour to deal fairly and fully with both questions.

The second question is, how are tests to be reported?

On receipt of a cell or battery of cells for testing, the first thing to do is to examine whether it has come safely in transit, set it up and label it, carefully study any correspondence regarding it and any instructions for its working. We will require to know at what ampere rate of discharge the battery is to be tested, and down to what limit of P.D. the discharge is to be carried; thus we get a table made out and approved of if possible by the maker or inventor of the cell.

Table I.

Ampere rates of discharge.	P.D. (volts) at end of discharge limited to	
10·0	1·85	on closed circuit.
12·5	1·8	
15·0	1·7	
20·0	1·6	

The above table shows how it would be made out for a cell of about 12 amperes discharge rate, which could be worked up to 20 amperes without trouble. It is wise to take lower readings than the so-called normal, for it might give better results in every way at a lower discharge. The P.D. limit, to which the cell may be discharged, differs somewhat; but so long as its value is stated in the report in a table as above, there is no harm done in fixing it a little high or low. The figures in Table I., and all figures given, are only as examples.

Table II. comes next, with all the dimensions of one of the cells to be tested; for this purpose it is necessary to take four or five cells, measure them up, and take the average of the four as the dimensions of one cell.

Table II.

Total weight of cell with acid complete	21 lbs.
Weight of plates per couple	14 lbs.
Number of plates per couple	5
Weight of acid per cell	4 lbs.
Specific gravity of acid before charge,	1,190. Twaddell.
" " "	1,220. "
Area of positive plates plates (both sides)	2 square feet.

Rates of discharge per square foot or pound of plates.		Square feet.	Pounds.
At amperes discharge	1·0	= 5	0·714
" "	12·5	= 6·25	0·90
" "	15·0	= 7·5	1·07
" "	20·0	= 10·0	1·43

We have now all the data obtainable, without the actual electrical tests. The amperes per square foot of plate allowable can be generally agreed upon, and from that calculate back for what the discharge rates in Table I. are to be. But if that is not given, then the amperes discharge per pound of plates in one cell may be taken, and this is the better way in most cases, for it is always easy to ascertain the weights, while in the case of Planté types of cells it is almost impossible to measure the area of plates.

If no figures are given for Table I., it is safe to begin the tests at 1 ampere per pound of plates, and make tests above and below that rate and fill in Table I. after.

The statement of this rate in the report on the tests is of great importance, for the performance of the cell under test may then be fairly contrasted with that of others at same rates per pound of plates.

We are now in a position to make the tests to fill in Table III.

Table III.

Rate of discharge amperes ...	10	12·5	15	20
Discharge in watt-hours ...	148	126	110	80
" ampere-hours ...	80	70	65	50
Mean P.D. volts per couple ...	1·85	1·8	1·7	1·6

State whether whole discharge taken without interval.

If intervals, how many, and for how long?

Now as to obtaining these figures:—There are three methods, the commonest being to employ a correct ampere-meter and voltmeter coupled in circuit with the cells. Of course the amperes in each cell may be taken as equal, but we must measure the P.D. of each cell separately, for they will not all drop to same P.D. at same time. After a trial or two the limiting P.D. may be taken from the cell which gives the medium result, but it is, perhaps, as good a plan to take the terminal P.D. of the battery of cells and divide by their number, checking the result by testing each cell separately from time to time with a 3-volt cell tester; if any one or more of the cells run down in P.D. before the others, these should be set aside as faulty, and the tests made on cells which reach the limiting P.D. at approximately the same time.

The second method is to use a wattmeter which will at once give watts, but the cell tester must be used to check each cell.

The third is to use a recording voltmeter and ampere-meter, or wattmeter recording watts; by this method the personal error is eliminated, and the results can be read off at once on the record.

A wattmeter made for a maximum voltage of, say, 8 volts, and a current from, say, 10 to 40 amperes meets all requirements; such an instrument need not make more than one revolution in 10 or 12 hours.

Tables I., II. and III. give the "observed results," from which the "calculated results" are obtained; no more than these three tables are required for any electrical engineer to judge of the merits of the battery, but as the tests are to be reported upon, Table IV. is calculated out for ampere-hours and couple results, and Table V. for watt-hours of complete battery results.

With the construction of these tables the expert's business may end, and the battery be left to its fate; but as comparisons are nearly always asked for, if the expert undertakes to make them he ought to do so in tabular form "parallel columns," as in Table VI.

And for the purpose of comparison the results of tests by some authority on a cell equal in size—that is, made for nearly the same ampere-hours capacity or with about same weight of plates—must be taken, and the name of the cell and authority must be given. Any other comparisons made, or made without reference to the cell with which the tests are compared, are either unwittingly or intentionally misleading.

But what are we to do if a cell of about the same size has not been reported on before? We must either calculate from a curve what the output would be if the cell were made up to the size of a cell, the results of which are known, or we must take a cell of same size and test it to get the comparative results, or decline to make any comparisons. Whichever procedure is adopted to make any comparisons, it should be briefly described; and a further precaution in making comparisons is to take the results at same discharge rates per pound of plates for both cells.

It is by overlooking these apparently obvious precautions that eminent experts have fallen into the most startling errors in a report now before us.

This paper is written not so much for people called upon to make tests, as for people who require tests to guide them. To do them justice, every statement should be beyond cavil.

Table IV.

Rate of discharge, amperes ...	10	12·5	15	20
Ampere-hours per lb. of 1 couple	5·7	5	4·6	3·5

Table V.

Rate of discharge, watts ...	20	25	30	40
Watt-hours per lb. of plate ...				
" " " battery ...				
Lbs. of plates per kw. in whole battery per kilowatt-hour ...				
Lbs. of battery per kilowatt ...				

Table VI.

Name of cell tested, A. Name of author of results, X.	A.	B.
Watt-hours per pound couple ...	8·36	6·12
Pounds of plates per kilowatt-hour ...	120	163
Pounds of battery per kilowatt-hour	193	265
Ampere-hours capacity of couple ...	12·23	9·3
Watt-hours capacity of couple ...	96	70·4
Rate of discharge per pound of couple	·65	1·3
Number or plates per couple ...	3	3
Weight of plates per couple pounds...	2·32 lbs.	2·32
Weight of one complete cell	4 lbs.	4 lbs.

The report should then conclude without comment, for with the concluding table anyone can draw his own conclusions, and it will be seen at a glance whether the comparison is fairly made or not.

The above table is an example of unfair comparison, for the poor showing of B cell is due to the one error in taking it at a rate of discharge per pound of couple, equal to 1·3 amperes, while A cell has a rate of only 0·65 per pound.

The fact is, the figures were obtained from the same cell. This table shows how the alteration of that one factor makes the whole results of the same cell totally different in two tests; in fact, unless this figure, given for both batteries, are alike in value, no fair comparisons can be made. In this table dimensions are alike in both cases. But simply altering the discharge rate per pound of couple makes all the vast difference. Of course, people will say this is no news, but the fact remains that few British-made reports give Table VI. in making comparisons; most continental reports do give, with great particularity, the pounds weight and the rate of charge and discharge per pound of plates or per couple.

Any comparisons made in which the weight per couple, the weight of battery, the rate of discharge per pound of couple, number of plates per couple, are not clearly stated for the cells compared are worse than useless, and may be positively mischievous.

It will now be understood what was meant when we started out with the statements that, while it is easy to test a battery, it requires considerable care and a level head to make comparisons of the results with other tests, especially as it is almost impossible to find complete results in those other tests, the most important figures being usually left out.

In a report by an expert now before us, a cell discharging at a rate of 1 ampere per pound of couple is compared with a Dujardin couple, the normal discharge rate of which is given (not by the expert) by the makers as 0·44 amperes per pound of couple, much to the disadvantage of the former.

(*To be concluded.*)

SAFE CARRYING CAPACITY FOR ELECTRICAL CONDUCTORS.*

By C. H. SEWALL.

The proper amount of metal in an electric conductor, sufficient to transfer a given energy, is governed by loss and carrying capacity.

Any conductor offers a resistance to the passage of current, causing a certain loss in energy, which passes from it in the form of radiated heat. The resistance offered is directly proportional to length and inversely to cross-sectional area. A long conductor has large radiating surface in proportion to the amount of current developed, and, consequently, in a connection between two points a considerable distance apart, the limit of economy in loss is generally reached without undue heating.

On the other hand, a short conductor, by reason of its low resistance, will cause a heavier current to flow; and, owing to the small extent of surface exposed for radiation, may develop a temperature dangerous to its surroundings, while the loss in energy still remains within proper bounds.

In the common acceptance of the term, carrying capacity means safe current capacity; that is, the current which may be carried without danger for a given cross-section.

The carrying capacity of a conductor is expressed by the number of amperes of electric current it will transmit without exhibiting more than a specified increase in temperature above that of its surrounding medium; and it is safe when that specified increase is safely limited.

To determine the proper limit is the undisputed prerogative of fire insurance companies. These companies have formed associations for mutual protection, and the culmination of this organisation is the National Board of Fire Underwriters, which issues a code of rules to be observed by property owners who desire to be insured by any of the companies in the associations. Municipal ordinances have been made in conformity with insurance rules, so that both the insured and the uninsured are bound by them.

Recently delegates from nine different bodies, including the American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Electric Light Association, National Association of Fire Engineers, National Board of Fire Underwriters, Underwriters' National Electric Association, have united in framing what is called the National Electrical Code for the government of the installation of electric wires and apparatus. It has been adopted by municipal authorities generally, and is now, for all practical purposes, as much the law of the land as if it had been decreed by State or National Legislature.

So far as the code relates to carrying capacity of conductors, it prescribes, in a table, a maximum number of amperes that can be sent through wires made from pure copper of 98 per cent. conductivity for three different conditions, and covering a range from No. 18 B. & S. gauge to 2,000,000 circular mils.

Here is a tabulated abstract from the national code:—

Cir. Mils.	Amperes rubber covered.	Amperes, W.P. wires.	Amperes, marine work.
2,000,000	1,050	1,670	...
1,000,000	650	1 000	...
500,000	390	590	...
413,639	...	...	340
250,529	...	...	2.5
B. & S. G.			
0000	210	312	...
0	127	185	...
6	46	65	...
14	12	16	12
18	3	5	3

It is the purpose of this paper briefly to discuss the general physical laws and conditions which bear upon the subject.

One of the old rules for determining safe current capacity was that of Clark, Forde & Co., English wire manufacturers.* It allowed 10 lbs. of copper per mile for each ampere of current. Translated into familiar terms this means that No. 18 B. & S. carries 2½, No. 6 12, and No. 0000 330 amperes. I will put them on the board opposite the figures of national code for same sizes:—

Size.	R.C. wires.	C., F. & Co.	W.P. wires.
0000	210	338	312
6	46	42	65
18	3	2½	5

Taking averages for all conditions, this ancient rule of thumb is not so far out of the way for those sizes with which the early manufacturers were familar.

Subsequently the British Board of Trade established the rule of 1,000 amperes per square inch of cross-section.

Here is the comparison with the code—

Cir. Mils.	R.C. wires.	B.T.	W.P. wires.
2,000,000	1,050	1,570	1,670
1,000,000	550	785	1,000
4-0	210	166	312
0	127	83	185
6	46	21	65
14	12	3¼	16

In March, 1884, Prof. George Forbes read a paper before the London Institution of Electrical Engineers, in which he exhibited mathematical calculations showing the number of amperes necessary to raise wires of given diameters to certain temperatures, and also calculations as to the effect of insulated coverings. He pointed out that the Board of Trade rule, 1,000 amperes per square inch, was uneconomical for small conductors and actually unsafe for those of large, though perhaps unusual diameters.

A. E. Kennelly read before the Edison convention at Niagara Falls, in August, 1889, a description of a series of

* Read before the Chicago Electrical Association, November 5th, 1897.

* Mr. Sewall has apparently made an error here. The firm is a consulting one, not manufacturing.—Eds. Elec. Rev.

experiments furnishing a great amount of reliable information. He did not, however, make experiments nor calculate tables upon the stranded conductors that are generally used when larger than 0000 B. & S. is required; and as the conditions in stranded conductors are quite different from those in solid ones, there was still uncertainty as to the proper current for large leads.

In November, 1896, Mr. Merrill, electrician for the Chicago Board of Fire Underwriters, made experiments in a station of the Chicago Edison Company, the results of which were issued in his laboratory report No. 523, and are now published as part of the code.

The maximum temperature to which a conductor may be raised must be limited by several considerations:

1. Heat increases the resistance of conductors.
2. Heat decreases the resistance of dielectrics.
3. Some kinds of dielectrics, notably rubber, will soften at high temperatures, and permit the metal to sink into them, bringing it nearer the surface of, or, possibly, quite through the insulating covering.
4. The temperature may rise to such an extreme as to cause a conflagration.

In 1888 a committee of the London Institution of Electrical Engineers reported the following rule:

"The conductivity and sectional area of any conductor should be so proportioned to the work it has to do that if twice the current proposed be sent through it the temperature of such conductor shall not exceed 150° F."

If 150° F. is the maximum limit, it is hardly possible to better the rule. It is supposable that no one will object to a factor of safety of two. The writer knows of one instance where, under very careful experimental conditions, a fuse that had been long in service successfully resisted current of twice its rated capacity.

As a starting point Mr. Kennelly thought that 75° F. represented a fair average condition, and his experiments were built up from that point. It was assumed that the temperature would increase as the square of the current strength. That being the case, a current sufficient to increase the temperature 18° F. (to 93°) would, if doubled, raise it four times 18°, or to 147, and just within the committee's danger line.

As Mr. Kennelly's figure for 0000 insulated wire run in moulding is 175 amperes, and the new code gives 210, then the rise in temperature under the latter figure will be as 175^2 or 30,625 is to 210^2 or 44,100; and as the former rise was 18 the latter will be 28, and doubling the current we shall have 112, or to a maximum limit of 187°. But 75° is not the maximum condition. It is conceivable that on a July day panelled wires may be surrounded by a medium showing 100° F., and it seems fair to suppose that if double the current in amperes given in the present code should be sent through a wire in the condition indicated, its temperature will be raised to 212°

Temperature limitations in an electrical conductor depend upon:

1. Electrical conductivity.
2. Extent of radiating surface.
3. Nature of radiating surface.
4. Nature and condition of surrounding medium.
5. Specific heat of metal.

Extent of radiating surface depends first upon form, a thin, flat strip having the greatest, a round solid wire the least. A stranded conductor has, for the same ohmic resistance, a larger circumference than a solid one, and its surface is corrugated.

The cuts illustrate the effect of form on radiating surface. Fig. 1 represents the cross-section of a solid conductor. Fig. 2 is the same circular milage made into a concentric strand of 37 wires. Fig. 3 is the same section in a cable containing seven strands, each strand of seven wires. Fig. 4 is the same surface in a rectangular cross-section

Approximately the distances around them, counting in all curves, in corrugations are as follows:

	Linear inches.
Circle	8·27
Strand	12 22
Cable...	14·14
Bar	22·73

And their radiating surfaces for equal lengths are in that proportion.

Roughened surfaces will give off heat faster than polished ones. If thoroughly blackened the coefficient of radiation is twice that of a polished surface. If covered with a black insulating covering radiation will be still further promoted. Prof. Forbes' calculations showed that the greater surface

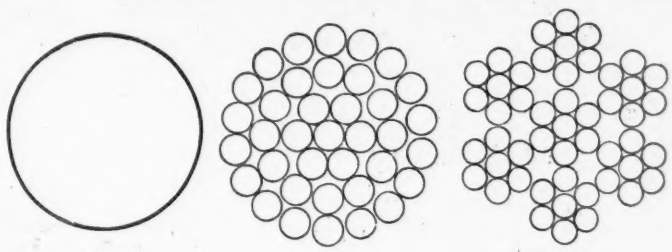


Fig. 1. Fig. 2. Fig. 3.

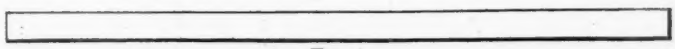


Fig. 4.

obtained by applying an insulating covering more than compensated, up to a certain thickness of coating, for the poor thermal conductivity of the insulator, and this was borne out by Kennelly's findings. Two of the latter's curves disclose the fact that a rubber-covered wire with an insulation 73 mils thick had a temperature elevation 30 per cent. lower than that attained by a wire of the same diameter but only covered to a thickness of 11 mils. From the tests the evidence was distinct that the effect of an insulated covering was to cool the wires if the covering was black; wire wound with white cotton was found to be higher in temperature with the same current, than a bare one.

(To be continued.)

CLEARANCE IN STEAM CYLINDERS.

[COMMUNICATED.]

At a recent meeting of the Institution of Mechanical Engineers, the statement was made that clearance was a mere bogey of the imagination, and for practical purposes might be ignored. This was no doubt a good deal startling to members, many of whom belong to what might be called the old school, for want of a better name. Yet there is a substantial substratum of truth in the matter if we examine it closely, and in the light of recent developments in engineering. Up to the incoming of electric lighting, high speed engines were novelties. The long stroke horizontal type had everything to itself, and ran slowly with an early cut-off. With ordinary valves therefore the distance from the face to the ends of the cylinder was considerable, and made up a very high percentage of its total capacity. As, however, original dynamo speeds were very high, different engines came into vogue to meet the requirements, and generally of an opposite character altogether to what the public had been hitherto accustomed. The stroke became short to obtain the fast running, and therefore the full pressure of steam was carried to a greater percentage of the length than was customary previously. Hence as regards clearance a gain was made every way by the change. This item was then made a much less proportion of the steam space before cut-off than before. It may be argued that the faster running engine, though losing less each stroke, performs a greater number of revolutions in a given time, and to some extent this contention holds good; but taking into account the faster speed as between the two classes of engine, the gain per stroke more than covers this by the reduced proportion of clearance space effected first by the shortening of the distance of valve face from cylinder end, and, secondly, by the greater amount of steam proportionately that must necessarily be carried in a quick running short stroke engine to what is customary when the revolutions are low and the length of piston travel a maximum. From a steam point of view every gain is therefore to be made by

shortening the stroke and running fast, because though cut-off does not take place early, yet the full travel being so much shorter there is not actually much material difference between a late cut-off with a short travel and an early cut-off with a long one. In the former case for power the cylinder is smaller in diameter, the decrease being made up by the extra revolutions run, and the gain is still further accentuated from the same cause by the lesser clearance space between the piston and the ends of the cylinder at full travel.

These being the primary advantages obtained by the adoption of high speed engines, and they are seen to be important, there are a few smaller ones to be noticed which, though not actually coming under the head of clearance, are in the same category. The passages being shorter may be made of a smaller section, and a saving be effected without loss of efficiency. The limit of size is freedom for the exhaust to get away, but the shorter length favours this discharge and the area may be smaller than when, as in the long stroke, some distance has to be travelled. Again, as cushioning is an accompaniment of all good running engines and beneficial effect is obtained thereby, it is obvious that where the clearance is small the same results from it can be had with a later closing of the exhaust where the passages are not long and of large area to be filled up. Generally, therefore, it appears there is a good deal in the view put forward that clearance is not the bugbear under the newer conditions existing with high speed engines that it was found to be with the older and larger engines, and if this is the case, it is another of the examples that the general adoption of electric lighting has been able to add to our common stock of engineering knowledge.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At an extraordinary meeting of the Institution of Electrical Engineers, held last Friday evening at the rooms of the Chemical Society in Burlington House, the discussion on Mr. Epstein's paper on "Accumulator Traction" was resumed and concluded. Mr. Desmond FitzGerald sent a very interesting communication which, owing to its character, will be best appreciated when published in the *Journal* of the Institution.

Mr. Wallis-Jones, after congratulating Mr. Epstein upon the scope of his paper, remarked that he thought the uphill work in connection with accumulator traction was about to be rewarded. He thought accumulators had seldom been scientifically used, to obtain the best results they must be kept as a single unit. He emphasised the question of "trip capacity," pointing out that there were two ways of dealing with cells; in one the capacity was sufficient for a trip or round journey, after which the cells were charged slowly; in the other the cells were used for a complete journey, and quickly charged. Cells would not work satisfactorily if they were split in sections and changes rung on the various groupings. At Birmingham he had noticed that with the battery split into four-quarter sections, frequently coupled:—

One quarter (*b*)
One quarter (*a*) Parallel with One quarter (*d*)
One quarter (*c*)

so that the half in the centre comprised two quarters paralleled, the common practice of the drivers in getting over a bad curve close to the depot was to alter the connections, so that the sequence was:—

One quarter (*a*) ... ... one quarter (*b*)
Parallel with
One quarter (*c*) ... ... one quarter (*d*)

The two quarters, usually connected parallel, sometimes showed as much as 5 volts difference in terminal pressure.

One of the important things to be noted in connection with accumulators on a car is the objectionable smell in the car itself. By suspending the cells below the cars outside its body, the rotting of the constructive materials by acid fumes is quite done away with. The rotting action otherwise becomes quite a serious figure in expenditure in the course of four or five years. Another advantage of the "single unit system" is the saving of breakages in ebonite cells, which, on the average, may be taken to cost 10s. a piece. By charging in one case, it is also possible to keep the leakage current low.

The traction cell of the future, Mr. Wallis-Jones thought, would be a Planté positive and pasted negative, which would reduce the cost of cleaning and upkeep. After some remarks on the probable life of a battery, and the weight of the cells used at Birmingham, he pointed out that perhaps by an oversight in the paper the negative plates were regarded as lasting for ever, whereas it would be nearer the mark to reckon one negative to every two positives replaced.

The combined system, as at Hanover, seemed likely to prove of great service in this country, where the objections of local authorities to the trolley wire are regarded as very serious.

Prof. R. H. Smith stated that he did not look with very sanguine feelings on the future of accumulators for traction. One of the difficulties, out of many, at Birmingham, was that the road-bed was badly laid, and the gauge of the rails varied with the weather. As a result, the cars tended to stick at certain parts of the line. He thought everyone knew of the two great causes that operate against the use of accumulators: firstly, the adding of another item to the total inefficiency of the system, the low efficiency of cells; and, secondly, the great handicapping influence of the large dead-weight carried. No doubt a large reduction will take place, but it requires a reduction of, perhaps, 60 per cent. to bring down this difference to any reasonable proportion in comparison with other systems. It had been his opinion for some time past that the use of locomotives drawing cars is desirable, because in a locomotive one necessarily desires great weight to enable the wheels to get a grip of the rails. There are, therefore, more chances of the advantages of this system coming out prominently than of other methods.

He differed from other speakers in considering that the Hanover system combines many of the disadvantages of both the accumulator and trolley systems. It seems more reasonable to use small locomotives charged from the trolley lines at points near the beginning of the sections of the track, where the cars are not permitted to continue on the trolley system.

Prof. Smith is perfectly sure that the London electric cabs are good enough to remain on the streets, and considers that they are educating the public to realise the possibility of mechanical traction on the streets of a large city; the public have in the past had many lessons in a contrary direction. One may notice, however, that they have become a little more noisy than when they were quite new.

Coming to the question of gearing, he said his *beau ideal* was to have no gearing at all. Every vehicle must have a frame that is, to a certain extent, elastic, and such elasticity is very destructive to gearing. Although some very ingenious attempts have been made to use worm gearing for electric cars, it must be remembered that this form requires more exact setting than does any other kind of gearing. Any small lack of adjustment leads to the worm being ground to pieces, while the same remark, in a lesser degree, applies to spur gearing.

The swing of the frame carrying the gearing in a vehicle produces certain objectionable dynamic and kinematic results; the changes have not time to sum up to any appreciable alteration in velocity, but the rate of change of velocity may be quite high, resulting in very large mechanical stresses between different parts of the gearing. This might be illustrated by considering what would occur if an ordinary horizontal engine were geared to its work by, say, spur gearing, the cylinders and gearing being mounted on a frame hinged at the driven shaft to the bedplate. Enormous strains might be brought upon the teeth of the spur gearing.

On these grounds he thought chain gearing was to be commended, and considered Reinold's chain gearing extremely ingenious in its details, while further improvements in chain gearing are quite possible.

Coming to tractive resistance, he pointed out that the resistance to drawing is very different to the resistance in the case of self-propulsion. It is a commonplace of railway engineering that the resistance in pounds per ton of a locomotive is greater than the resistance of the train it draws, while it has been known for many years that the towing horse-power for a given speed is less than the horse-power necessary to self-propel the same ship. One may be three

times as great as the other. Rail resistance is a very large item of railway tractive resistance, because the locomotive could not steer except by side pressure on the rails.

Wind resistance is usually small, chiefly because the length of a train is small, and it is also low with road cars because the velocities attempted are small. The ordinary law gives the resistance varying as the square of the velocity, but this gives a too rapid increase with small velocities. Prof. Smith then gave the following formulæ as illustrative of this point:—

The ordinary formula may be written—

$$R' = c' v^2.$$

An approximately correct formula is—

$$R = c\, v^{1+m} v$$

where $c = 5\, c'$, for the same set of conditions and circumstances,

and $m = \cdot 03$.

The magnitude and rate of increase are the same in both formulæ, where $v = 10$ miles per hour.

Also the power required may be obtained from:—

$$1 \text{ H.P.} = 375 \frac{\text{mile-pounds}}{\text{hour}}$$

$$= \tfrac{1}{6} \frac{\text{miles-tons}}{\text{hours}}$$

or, $\frac{1}{6}$-ton exerted at the rate of one mile per hour = 1 H.P.

Another speaker gave some interesting figures as to tractive resistance he had found by experiments with an iron-tyred phæton. These are as follows:—

	Muddy road.	Very wet.	
Asphalte	22	23	22
Good wood	22—29	31	30
Wood	38	...	...
Good macadam	52	50	49
Macadam	60	51	56
Soft macadam	97*	51**	54°
		80†	68¶

* New. ** Three weeks later. † Four or five days old. ° Four days later. ¶ Week later.

The runs extended over 6 to 7 miles of road; the average pull was found to be 45 lbs. per ton, and something between 45 and 50 lbs. may be taken as the average for London.

Mr. Bell suggested that mechanical engineers might advantageously endeavour to insert a spring between the felloe of a wheel and the road, and that in this direction something has yet to be done.

Mr. Dickinson sent a long contribution, in which he expressed his opinion that it has yet to be demonstrated that accumulators will do what is required in traction work, and cited the financial results at Birmingham as worthy of close attention by all those who believed in accumulators. He said:—"A more sanguine body of men I never met with than the advocates and representatives of secondary battery manufacturers."

Sir Henry Mance made some remarks on what he had seen at Barking and at Hartlepool, referred to the trouble and inconvenience so frequently occasioned by the connections and contacts, and expressed his opinion that one weak point about accumulators was that one never knew when they were thoroughly charged up, or when they were going to give out.

Mr. Epstein replied to the discussion in writing, owing to indisposition. He dealt fully with statements made by Mr. Manley regarding the cells used in Dresden, and considered that no accumulator in existence gives such a good energy efficiency as 90 per cent. in actual practice. He thought soft rubber envelopes for plates would get hard and crack, while celluloid was uncertain. He appreciated what had been said about Birmingham, and believed that unsatisfactory results there are not a criterion of the merits or demerits of the battery principle. His ideas corresponded exactly with those of Mr. Manville. In reply to several speakers, further statistical data of the Hanover tramways were given, which no doubt will be duly appreciated when the *Journal* comes to be perused, but hardly bore any significance at the time they were read to the meeting.

This closed the discussion. If any one thing was more evident than another, it was the air of suspended judgment with which members rose to speak, and the general tone of hopefulness that characterised their remarks. In short, accumulators, though admittedly imperfect, have not yet been condemned, and the Institution, as represented by these members who have had their say, is waiting, expecting and hoping that accumulator traction may be given a fair and impartial trial, under favourable conditions, in the near future, when most appeared to think that better results will accrue than have yet come before the electrical world.

CORRESPONDENCE.

Wireless Telegraphy.

With reference to Prof. Silvanus Thompson's disclaimer in the REVIEW of December 17th, and having been present at the lecture in question, I would like, with your permission, to make a remark or two.

After the lecture, and amongst many others, I went to have a look at the apparatus, and to see how the Hertzian waves are propagated, or projected, or radiated, whichever may be the correct term. After admiring the Professor's beautifully graphic mechanical illustration of the oscillations, and having taken a peep behind the scenes to inspect the source of electrical power used to generate the influence, I ventured to address the learned Professor on one point that did not appear quite clear to me, to wit, the *spreading* of the Hertzian waves.

I wanted to know if I had understood aright that these waves *do* spread in all directions when sent out through space.

Finding, from the Professor's reply, that I had correctly interpreted his remarks, I told him of a lecture on the same subject that I had attended where the lecturer explained the difference between electro-magnetic waves of low frequency, and these electrical oscillations of high frequency, illustrating same by a diagram which showed the former as a series of concentric circles, and the latter as lines cutting through them from the centre, or source of influence. There was also depicted on the diagram a mountain, through which the Hertzian wave, or impulse, was supposed to pass.

After complimenting the Professor on his interesting lecture, and able exposition of how 'tis done, I took my leave.

Of course, some one else who *was* "firmly convinced that 'Marconi' waves don't spread" may have spoken to the lecturer after the meeting, and it may have been simply a coincidence, but the point referred to by Prof. Thompson is identical, and gives me the impression that, whether these electric waves spread or not, the Professor got "mixed."

Regarding Prof. Thompson's expression referring to the Signor, a companion and myself certainly understood the Professor to say that "Mr. Marconi had done nothing new."

One of the Audience.

Re Shoreditch and its Dust Destructor.

With reference to your own queries I would point out that for you to assume certain figures, seems only waste of space in your valued journal, more especially when one considers that an invitation was sent you to visit these works two months ago, viz., on October 15th last, by Mr. C. Newton Russell, our chief engineer, who, in reply to a telegram received from you, offered to give you any information direct, and, as you have not thought fit to avail yourself of the offer, I must decline to enter into the controversy, and ask you, with others, to await our first year's official figures.

H. E. Kershaw.

[Mr. Kershaw is not quite correct in saying that an invitation was sent to us to visit the Shoreditch works. We asked Mr. Russell a question by telegram which he very kindly answered, and, moreover, said he would give us any

further information if we required it. There was no special reason for us to visit Shoreditch at that moment, nor did we construe Mr. Russell's telegram into an invitation. But all this is quite beyond the issue that was raised. We suggested that there was rather more coal burned in a month than one would have expected, and we endeavoured to show by means of an imaginary output, that the burning of coal could scarcely have been confined to Sundays. It was quite easy for Mr. Kershaw to have compared our assumptive figures with those that actually occurred. He might have proved our assumptions to be absurd, or, at any rate, not representative of what actually took place. Instead of this, however, Mr. Kershaw declines to enter into the controversy because we had not thought fit to avail ourselves of an obscure invitation to visit the Shoreditch works. We have no desire to see the Shoreditch works a failure in any sense of the word, and if the first 12 months' work show that their combined scheme of dust destruction and electric lighting is successful, we shall be the first to acknowledge it.—Eds. Elec. Rev]

Your correspondent, "X. Y. Z.," in his communication of last week, indirectly touched upon a question which, to my mind, is one of serious import, namely, the impetus which may and is given by the use of well known names, and the inadvertent remarks and may be after dinner speeches of the men who bear these names, to impress upon unthinking members of town councils, schemes absolutely untried—and, when tried, found woefully wanting.

I was pleased to see that another well known electrical journal has taken the same view, as the following extract will show: "The dust destructor appeals strongly to the imagination of the average councillor or vestryman, and I fear some local authorities will be putting their foot, or feet, in it (not the destructor) before long. Lord Kelvin's name carries such influence, that it is possible that his special observations to Shoreditchians have been hurtful by being generalised." I have been induced to look through the account of the opening ceremony, and as I read through the eulogistic speech of Lord Kelvin, speaking upon a subject of which he knew nothing, excepting what he had been told, I could not but wonder as to what his feelings would be, if he has become cognisant of the circumstances set forth in your journal and impressed as it were with the seal manual of Shoreditch itself. Lord Kelvin is reported as saying, "The Shoreditch electric light commences with dust, and *dust only*, for its fuel." Lord Kelvin believed that he was stating a fact—what must he have thought if he read the letter of the "Engineer-in-Charge, Dust Destructor, Shoreditch," *City Press*, August 11th. This pathetic letter admits that "It is the fact that coal was used on the opening day, but that was because we had no refuse," (no refuse ! ! !) "and, therefore, had to burn coal to generate the steam required—but not in the destructor furnaces as your correspondent seems to think." Lord Kelvin says "dust only," the engineer says they had "no refuse" dust, but burnt "coal to generate the steam." I guess, Mr. Editor, that his Lordship was not in the coal secret, and I have also a very strong opinion that in the end it will be found that honesty is the best policy.

Power.

Telephones.

In a recent visit to Douglas, in the Isle of Man, I was agreeably surprised to find so many subscribers on the telephone.

I found, on inquiry, that a £5 telephone had been in existence there since 1882, and that it has as many as 315 exchange wires in a population of 19,000, equivalent to 17 in 1,000.

Compare this with towns in Great Britain which have, perhaps, three or four per 1,000. How can one understand the apathy of Englishmen in submitting to such a tyranous monopoly and such obstruction by the Post Office.

These facts are fully borne out by continental statistics, which show that the cheaper the service, the greater the proportion of the inhabitants who use the telephone, and the better it pays.

Anti-Monopoly.

PHYSICAL SOCIETY.

Ordinary Meeting, December 10th, 1897.
Mr. Shelford Bidwell, President, in the chair.

Mr. Albert Campbell read a paper on Temperature Compensators for Standard Cells.

Some account of the methods adopted by the author has already been published, he now describes the apparatus. The first compensating arrangement (3) can be used for keeping the potential difference between two points of a conducting system constant at all room temperatures. Or it can be adapted to modify the voltage of a standard cell to some convenient whole number. This arrangement (3) resembles a Wheatstone's bridge with the galvanometer-branch removed. One pair of opposite arms is of copper, the other pair is of manganin. The bridge battery is a Leclanché cell; this supplies the auxiliary voltage, which is utilised at the two galvanometer points of the bridge, and is there applied in series with the standard cell. In an alternative method, suggested by Mr. C. Crawley, only one of the four arms is made of copper. The second compensating arrangement (4) is intended to maintain constant potential between two points, at all room temperatures. For this purpose, two wires, a and b, are connected in parallel. One of them, a, is all of manganin, the other, b, is partly copper and partly manganin. Constant *current* is applied at the ends of a and b. The various resistances are chosen so as to give constant difference of potential between the ends of the manganin portion of b. By this method the potential difference can be maintained to within 1 in 2,000.

Mr. Swinburne said that 12 or 13 years ago he had given a good deal of thought to compensation by wires of different temperature-coefficients. The first thing he tried was a Wheatstone's bridge. This was compensated by making the bridge arms of wires whose temperature coefficients differed—as, for instance, platinoid and copper. He then applied the same principle to the compensation of standard cells, using a potentiometer method that gave direct readings, and to the compensation of voltmeters and wattmeters. These results were published between 1885 and 1890, in the electrical journals. He believed that Mr. Evershed had also developed this idea, by putting "back" turns on voltmeters, and by other differential devices. The details of Mr. Campbell's apparatus had a few points of special interest. The way in which he connected up the bridge (3) seemed particularly worthy of notice.

Prof. Ayrton asked whether thermo-electric effects produced difficulty in the compounded arrangement.

Mr. Campbell said the system was symmetrical, and the thermal currents were consequently neutralised.

Mr. Appleyard, referring to experiment (2), said it was identical with one that had been shown for the past eight years at lectures at Cooper's Hill College. It was specially interesting as illustrating the deflection that occurs with girders and bridges when exposed on one side to sunshine.

THE ENGINEERS' STRIKE.

On Friday last the Conference came to a close with what appeared to be a settlement on everything except the question of hours. On this the employers remained obdurate, and the whole of the matters in dispute were to be submitted to ballot, the Conference to meet again on Tuesday, the 28th inst., to hear the decision of the ballot. We may take it that the voting will be in the direction indicated by the men's executive, and as the executive have really made up their minds individually, though, perhaps, not collectively, that the position is lost, we think it a pity that some little work could not have been secured for the men before Christmas. As it is, there will be an idle and starvation Christmas for thousands of poor fellows who are thus sacrificed to what cannot be described as other than a formality. The point of which so much has been made is that of collective bargaining. Now, collective bargaining from a trades union point of view means that employers individually shall be compelled to bargain with men in a collective capacity. Naturally enough the employers want a little collectivism on their side, but this yearning for communism, which is a noble aspiration in a man who sells labour for money, becomes brute force and tyrannical oppression in a man who gives money for labour. We confess we cannot see where the difference comes in. But the employers have not repudiated collective bargaining. They say, let the men in the first instance deal with their own employers. In case of disagreement, let the local branch of the union negotiate with the local employers' association, and failing then to come to terms, let the central authorities take the matter in hand. This is the system that Mr. Knight says has worked well in the boiler makers union, and has produced satisfactory results for the iron and steel trades of the North of England for nearly 30 years. The employers are agreeable to these terms, but will not refer the matter to compulsory arbitration if these measures fail.

It seems to us that the cause of much of the mischief wrought by trades unionism has been due to want of cohesion amongst employers. The agreement as to a reasonable amount of collective bargaining will ensure a continuance of federation among employers, and where employers are not federated, there is always the danger of an attack on an individual, which may spread into a huge strike and lockout. When the trades unions know they cannot make their unreasonable demands, except through the final leave of two head-quarters, the chances are that the local power for mischief which has of

recent years enabled the tail to wag the dog will be curbed. At the same time, any tyrannical employer will better be kept in check, and both sides should be great gainers. If a strike can have a comic aspect this has been provided by the Bishop of Hereford and some Oxford professors, who, in utter ignorance of the details of engineering operations, have been poking their noses into this business. "Hereford" would compel all labour disputes to be referred to a properly constituted court of arbitration, as though such disputes could be settled on points of law. This alone shows that the good bishop has not grasped the situation. Compare the ecclesiastic and academic claim that the employers' conditions strike at the very root of unionism with Mr. Knight, the general secretary of the boiler makers. Mr. Knight says that "the principle of collective bargaining in fixing the price of work is one of the uttermost difficulty. No hard and fast rule of collective bargaining can be laid down. To do so would be to necessitate the picking and choosing by employers of the best men, and the enforced idleness of the old and less competent, for one of the items of collective bargaining is the minimum wage theory." Mr. George Livesey points out that five-sixths of the workers of the country are non-union men, and have no collective bargaining; yet they do well, and often do better, than the unionists, with all their collectiveness.

Mr. Bernard Holland also calls the attention of the Bishop to the Trade Union Act of 1871, wherein collective agreements are barred by statute, and trades unions are free of any award being made against their collective funds. Neither men nor masters can enter into legal agreements to accept arbitration whose awards are not enforceable. Yet employers are being soundly abused because they will not accept a situation which the law has debarred them from accepting in order to protect trades unions. Where it suits trades unionism to accept a situation it is all very good, and employers must be abused for not falling into line; but let an award go against the unions, and its heads disappear like so many horns of a snail, and a formless, boneless mass remains, of which no one can take hold. We are much inclined to think that the present dispute will have had a powerful educational effect, not alone on the men, but on the employers and on the public. Already the public seem to have some appreciation of the facts. They have, on the whole, held aloof from the quarrel. Whatever were the wrongs and rights of the celebrated dock strike of some years ago, the public gave to the strike very considerable aid and sympathy. Nothing of the sort has been observed in the current strike, because the public see simply thousands of well-paid men idling for what the public itself does not possess. The London warehouseman, who often toils until 10 p.m. without extra pay, cannot see much in an eight hours' claim, nor does he see why mechanics should possess the right to interfere with the management of a place; and the public generally, whose lot it is to work overtime for nothing extra, wonders at the folly of men who get double pay for a good proportion of overtime and sundry extra allowances also. So the public has not risen as they rose for the dockers, who asked for what the public thought they should have—the living wage.

The present prospect of settlement, such as it is, seems to be based on non-interference with shop management, equal treatment of unionists and non-unionists, no limitation of apprentices, restriction of overtime to 40 hours in any four weeks (? consecutive), and freedom to work piecework and rating according to ability, but as we go to press there seems but little hope of any immediate termination of the dispute.

LEGAL.

Levy *v.* National Telephone Company.

In the Court of Appeal on Friday, the 17th inst., Lords Justices Smith, Rigby, and Collins, in the action of Levy *v.* The National Telephone Company, Limited, heard an appeal by the company from a mandatory injunction granted against them by Mr. Justice Day to remove, within two months, certain telephonic wires and cables erected over and above the plaintiff's premises in Whitechapel Road.

Mr. Asquith, Q.C., appearing for the appellant company, said they were incorporated for the purpose of supplying telephonic communication, and since 1884 had been acting to that end under license from the Postmaster-General. Although they were not acting under statutory powers, they were in a position to obtain such powers, and for some 13 years the wires complained of had been in the position on which the action was based.

Mr. Upjohn, Q.C., (for the plaintiff), denied that they had been in position for 13 years, or anything like that time, and said that what plaintiff complained of was that, without her consent or approval being asked, the wires had been fixed to the roof of her house, which had, moreover, been damaged by it.

Mr. Asquith said these questions might be raised at the trial; but the point now was whether an interlocutory injunction should have been granted; he submitted not, in view of the plaintiff's remedy at law.

Lord Justice Smith: Do you mean to say that if a wire is put on my house I am not entitled to have it pulled down?

Possibly so, replied Mr. Asquith, but these wires had been in their present position some 13 years, and according to the plaintiff's own evidence, without the slightest danger or inconvenience, and defendants were in a position to obtain statutory authority for what they did.

Lord Justice Smith thought this should have been done at first, instead of the high handed proceeding pursued.

Lord Justice Rigby: And could you do it without compensation?

Mr. Asquith did not say that. Although he might not be able to produce statutory authority for what had been done, was it a reasonable thing to order these wires, considering the object for which they were used, to order that they be removed within two months.

Lord Justice Smith: Has anybody ever yet laid it down that an arbitrary trespass can be justified by saying: "We'll compensate you?"

Mr. Upjohn, in support of the injunction, said there were about 250 wires, including three cables, over the plaintiff's house, some 3 feet above the roof, and the affidavits showed that they were a great annoyance to persons sleeping in the room immediately beneath, beside being a source of danger in gales and snow storms.

At the conclusion of the arguments on these lines, Lord Justice Smith said he thought Mr. Justice Day's order the correct one, and that it should be upheld and the appeal dismissed. It was said plaintiff might have cut the defendants' wires, but she preferred the more reasonable course of coming to the Court for relief by compelling the defendants to take them down. This must be done, but two months from the present date would be allowed that the defendants to remove them. The other Lords Justices concurring, an order was made accordingly.

Westminster Electric Supply Corporation *v.* The London Hygienic Ice Company.

In this action the defendants, on Thursday, 16th inst., appealed to Lords Justices Smith, Rigby and Collins, from an interlocutory order granted by Mr. Justice Day, by way of restraining them in what was technically an action for a nuisance occasioned, it was said, by the brine and other materials used by defendants in their manufacture of ice percolating through the floors and walls of their building to the damage of the plaintiffs.

Mr. Bray, Q.C., for the defendant appellants, pointed out the special steps they had taken to prevent any cause for complaint, which went so far back, he said, as August, 1894.

Lord Justice Smith, asking on what grounds the interlocutory injunction was granted, Mr. Bray said it was stated that the Duke of Westminster, as the ground landlord, had threatened all sorts of things, but the appellants were willing, and, indeed, had actually appointed, under the lease to defendants, an arbitrator to deal with the matter of complaint, and to say whether or not they had broken the covenants under which they held the premises. He was proceeding to indicate the evidence tendered by the plaintiffs to the learned judge in support of the application which he granted, when

Mr. Moulton, Q.C., for the respondent plaintiffs in the action, said he might as well at this stage say that he must ask for time to answer some of the affidavits on the other side, which had only just been delivered.

Lord Justice Smith: Why can't you go to the suggested reference on a matter of this kind?

Mr. Moulton said he had no objection, but as a preliminary, what the plaintiffs complained of must be stopped at once. He was sure there could be no sufficient answer given to the plaintiffs' evidence on that point.

It was eventually arranged that an expert should be called in as arbitrator to say what should be done to remedy what was complained of, both parties signing an undertaking to bear the expense, according as he might determine, and the injunction meantime to be stayed until further order.

Ryman *v.* Salmony & Co.

This case came before his Honour Judge Lumley Smith, Q.C., on Thursday last week, in the Westminster County Court. It was a claim for £10 11s. for commission and postages. The plaintiff, Gabriel Ryman, a traveller, deposed that he was engaged by the defendants, electrical engineers, of 118 and 120, Charing Cross Road, at £8 10s. a week salary and commission, and 2½ per cent. on wiring and casings, and 5 per cent. on all other accessories. He went away, and subsequently got a cheque for £5 on account of commission. He asked for 11s. and odd for postages, but had not had it. He left in August, and never had been able to get an account from them. On behalf of the defendants, it was said that the commission was 2½ per cent. only, and the money paid amounted to £190 10s. 9d. He had been overpaid, yet there was still £68 outstanding.

His Honour said the claim of 5 per cent. was not proved, and he gave judgment for the balance of £8 10s., with liberty to apply as to the account.

The Commissioners of Sewers *v.* City of London Electric Lighting Company.

On Monday last, in the Court of Appeal, the Commissioners of Sewers of the City of London, in an action against them by the City of London Electric Lighting Company, Limited, appealed to Lords Justices Smith, Rigby and Collins from an order made by Mr. Justice Day in Chambers, reversing an order of Master Pollock, giving the defendants unconditional leave to defend the action as regarded a sum of £1,142 2s. 7d. out of a total claim of £6,439 odd, and signing summary judgment for the plaintiffs as to the balance, which was in dispute between the parties.

Counsel for the appellant Commissioners said plaintiffs in the case were the undertakers for lighting the City with electricity under a provisional order, which had since received the assent of Parliament. Under this provisional order the local authority might from time to time appoint electric inspectors under the board, prescribe their duties, and the fees to be taken. The action was brought in respect to these matters, and a counterclaim was set up on the contention that under Clause 47 of the order, the fees, unless they could be agreed upon, should be ascertained by a Court of Summary Jurisdic-

tion, or by the Board of Trade, and be paid by the undertakers. What took place was, that under the provisions of the order, the Commissioners of Sewers as the local authority appointed an electric inspector of the electric lighting applied to the City in 1896-97. In July of the last-mentioned year the clerk to the Commissioners of Sewers wrote to the company forwarding an account of the electrical inspection, and asked that the Commissioners might be re-imbursed the amount. The company wrote that it was a condition precedent that the amount should be ascertained between the parties; in short, their eventual answer to the request was that they owed nothing. They raised no question as to the amount, but simply said, "We don't recognise your claim." He proceeded to read a correspondence in the matter, in order to show that the company had not been altogether consistent in their attitude, as they offered to pay the Commissioners some £2,200 odd out of the £6,000; in other words, to deduct from the total certain amounts whose liability they disputed.

Lord Justice Smith asked was not the true meaning of Clause 47 that the parties were not to go into a court of law at all.

Counsel for the appellants said the liability being admitted, a Court of Summary Jurisdiction would settle any differences as to details, but what was said was that they owed nothing; and he submitted that defendants ought not to be refused a hearing of their case, as was the effect of Mr. Justice Day's order.

Counsel for the respondent company said that they admitted liability for some of the items, but denied the others; and counsel for the appellants said he certainly understood their case now to be a total denial.

Lord Justice Smith asked wasn't this a miserable squabble between two large City bodies, and why couldn't they settle it? Why not pay the whole amount and bring a cross action?

Appellants' Counsel said liability was denied.

Lord Justice Smith asked why should not judgment be signed against appellants for the £6,000 odd, and execution be stayed as to the £1,142 odd, for them to settle the matter?

Counsel said he had no objection, but there was no reason why the other side should have £1,100 of their money in their pockets, pending what they themselves in the correspondence called a *bond fide* dispute as to liability. They offered to bring the whole money into Court, and the Master, thinking that a fair thing to do, gave them the opportunity of having the case tried before the ordinary tribunals. Mr. Justice Day's disallowance and over-ruling of this, he submitted, should not be sustained.

Counsel for the company, said thelearned Judge, after giving great care to the consideration of the statute, thought it clear that plaintiffs were entitled to be paid this sum on June 30th. The learned counsel on the other side was altogether in error in saying that they repudiated liability. It was nothing of the kind; they only repudiated certain items, and not the fees at all; they had never repudiated out-and-out, but only such items as, if due, would be so held by a Court of Summary Jurisdiction.

The Judge said he thought it perfectly clear that this was a condition precedent, and so gave judgment for the whole amount. He submitted that on the clause and the facts this decision should be upheld.

In the result, their Lordships coincided with that view, and dismissed the appeal.

United Gutta-Percha Company, Limited *v.* Welch & Co.

This was an appeal heard before Lords Justices A. L. Smith, Rigby and Collins, on Tuesday, from an order of Mr. Justice Day, giving the plaintiffs leave to sign final judgment under Order 14. The defendant, who, says the *Times* report, was an electrical engineer, bought goods under a contract of sale from the plaintiffs, who were a company carrying on business in Scotland, out of the jurisdiction of the High Court, and were in liquidation. One of the terms of the contract was, that the plaintiffs should deliver the goods to the defendant properly packed with a view to their being sent abroad. The plaintiffs having brought this action to recover the price of the goods, the defendant alleged that the goods had not been delivered properly packed, and claimed to deduct the sum which he had spent in having them properly packed. Mr. Justice Day, on the hearing of the plaintiffs' application for summary judgment under Order 14, said that the defendant's complaint was a matter of counter-claim, and not of defence, and that the plaintiffs were entitled to judgment in this action, leaving the defendant at liberty, if he thought fit, to bring another action against the plaintiffs for breach of contract. It was now argued on behalf of the defendant that the plaintiffs' breach of duty with regard to a matter which was part of the contract was, on the authorities, a matter of defence, and that the defendant ought not to be obliged to prove in the liquidation of a company out of the jurisdiction.

Mr. Montague Lush appeared for the defendant; Mr. Addleshaw for the plaintiffs.

The Court held that the plaintiffs ought not to have been allowed to sign summary judgment, and that the defendant ought to be allowed to defend the action.

North Staffordshire Trams Company *v.* British Electric Traction Company.

In the Court of Appeal on Saturday, before Lord Justice A. L. Smith, Lord Justice Rigby, and Lord Justice Collins, this appeal was heard. It was an appeal by the defendants from an order made by Mr. Justice Day, on the application of the plaintiff tram company, restraining the defendant company from interfering with the plaintiffs' tramway at Burslem. It appeared that the acts of the defendants of which the plaintiffs complained, were being done while the defendants were acting in the exercise of their statutory rights, the defendants being the transferees of certain rights and authority granted by the Potteries Extension Tramways Order, 1896, as confirmed by the Tramways Order Confirmation No. 2 Act, 1896. This order authorised the construction and maintenance of certain tramways described therein. The defendants commenced an action for damages for trespass, and for an injunction, and Mr. Justice Day made an order granting an interim injunction till the trial of the action. Mr. Balfour Browne, Q.C., Mr. Cripps, Q.C., Mr. Asquith, Q.C., and Lord Robert Cecil appeared for the defendants in support of the appeal; Mr. Lawson Walton, Q.C., Mr. Herbert Reed, Q.C., and Mr. Carrington for the plaintiffs. While the arguments were proceeding it was arranged that the case should be settled, the defendants undertaking to let matters remain as they were until January 1st, and to proceed with their works as expeditiously as possible after that date, and to grant the plaintiffs certain facilities for working their tramway. On these terms the injunction was dissolved.

Aluminium Company *v.* Dormeyer Company.

Mr. Fletcher Moulton, Q.C., with whom was Mr. Bousfield, Q.C., and Lord Robert Cecil, applied on 21st inst. to Mr. Justice Sterling for an interim injunction on behalf of the Aluminium Company, of Oldbury, against the Dormeyer Company, of Germany, restraining them till the trial of an action from infringing the plaintiffs' patent for the making of lodium by an electrical process. The patent dated from the year 1890, and although the plaintiffs could hold no patent for the substance, they had a patent for the mode of manufacture.

Mr. Terrell, Q.C., with whom was Mr. Walter, on the other side, contended that as they had sold the article for over 15 months in England, and had advertised it for sale, there was no necessity for an interlocutory injunction, but he would keep an account. There was an action, in which judgment had not yet been delivered, in Berlin.

His Lordship refused the application.

BUSINESS NOTICES, &c.

Universal Electrical Directory, 1898.—All changes of address should be notified not later than December 31st. Advertisement copy should also be sent in by that date to H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, E.C.

Electrical Wares Exported.

Week Ending Dec. 21st, 1896	£	s.
Alexandria. Teleg. mat.	80	0
Amsterdam	50	0
Bangkok	21	0
Bombay	99	0
Brisbane. Teleg. mat.	256	0
Buenos Ayres	36	0
Calcutta	630	0
Cape Town	452	0
Colombo	8	0
Demerara	23	0
Durban	272	0
East London	2,130	0
Flushing	80	0
Launceston	230	0
Madras	55	0
Melbourne	232	0
„ Teleg. mat.	45	0
Oporto	16	0
Ostend	6	0
Port Elizabeth	18	0
Port Said	6	0
Rotterdam. Teleg. mat.	24	0
Shanghai	625	0
Singapore	9	0
Sydney	473	0
„ Teleg. mat. ...	213	0
Stockholm. Teleg. mat.	179	0
Trinidad. Teleg. mat.	94	0
Total	£6,362	0

Week Ending Dec. 21st, 1897.	£	s.
Adelaide	17	0
Amsterdam	45	0
Antwerp	105	0
„ Elec. cable ...	900	0
Bangkok	413	0
Beira	122	0
Buenos Ayres. Teleg. mat.	100	0
Brussels...	210	0
Calcutta...	211	0
Cape Town	34	0
Colombo	62	0
Delagoa Bay. Teleg. mat.	180	0
Durban	1,310	0
„ Teleg. mat....	670	0
Flushing	65	0
Fremantle	319	0
„ Teleg. mat.	1,145	0
Geraldton	60	0
Gibraltar	227	0
„ Elec. cable...	2,300	0
Gothenburg	43	0
Hiogo	35	0
Hobart	49	0
Madras	196	0
Melbourne	49	0
Nagasaki. Teleg. cable	9,000	0
Odessa	180	0
Port Elizabeth. Teleg. mat.	121	0
Rotterdam	11	0
St. Petersburg	382	0
Shanghai	656	0
„ Teleg. mat. ...	137	0
Singapore	70	0
„ Teleg. mat.	25	0
Sydney	423	0
Townsville	140	0
Wellington. Teleg. mat.	1,808	0
Yokohama	379	0
Total	£22,199	0

Foreign Goods Transhipped.

	£	s.
Stockholm	50	0

Alleged Fraud.—A man was charged at Glasgow last week with having obtained a number of incandescent lamps and electric lampholders from the International Electric Company, by presenting a note purporting to be from an engineer in Wellington Street.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held last Friday before Mr. Registrar Linklater, John Orme attended for public examination. He carried on business as a scientific apparatus manufacturer, under the style of J. Orme and Co, originally at 65, Barbican, and since September last at 6, Cross Street, Finsbury, and 62, Compton Street, Clerkenwell. The accounts show total liabilities £2,453 13s. 9d. (unsecured £1,744 16s. 3d.), and assets £118 18s. 1d. In 1893 he promoted Orme's Electric Signal Company, Limited, with a nominal capital of £7,500, for the purpose of taking over a patent electric fog signal. As vendor he received £6,000 in shares, but the company went into liquidation in 1895. He attributes his failure primarily to the excessive amount paid to a retiring partner in 1881; to heavy strain on the business in paying a composition of 7s. 6d. to creditors for £3,000 in 1891; also to gradual decline in the business through want of capital. The examination was concluded.

Liquidation Notices.—At meetings held on November 26th and December 13th, at 6, Old Jewry, E.C., the Electrical Traffic Syndicate resolved to wind up voluntarily, Mr. M. Jenks, of the above address, being appointed liquidator.

At meetings of the Salt Lake and Ogden Gas and Electric Light Company, held on November 12th and December 10th at Winchester House, E.C., a resolution was passed winding up voluntarily, and appointing Mr. E. A. King liquidator.

Business Announcement.—We understand that Messrs. D. Bruce, Peebles & Co., of Tay Works, Edinburgh, are about to open an electrical department. Messrs. M. T. Pixton & Roland S. Portheim, will take charge thereof, the former as electrical designer, and the latter as manager of the department. It will be remembered that these gentlemen were recently with Messrs. P. R. Jackson & Co., of Manchester, from whose employment they have now resigned.

Copper.—The deliveries of copper during the past fortnight having exceeded the supplies (11,142 tons of the former, against 10,701 tons of the latter), and the stock in England and France and afloat thereto having decreased, according to the *Financial News*, to 32,650 tons, the price has improved a further 7s. 6d., standing now at £48 7s. 6d. against the even figure a fortnight and a month ago, which was exactly £1 less than the price at the end of November, 1896, while at the same date in 1895 the price was £43 2s. 6d., and in 1894 only £39 15s.—the last being, with two exceptions early in 1895, the lowest price at which copper has stood at any month-end in the past three years.

Electrical Advertising.—In our last issue we gave a few notes *re* Gent's "Allaxic" electric advertising system. This apparatus has been patented by Mr. J. T. Gent, of Flushing, Falmouth, and is intended for the purpose of rendering illuminated signs or the parts of an illuminated device or a series of separate illuminated advertisements more attractive by causing the letters or parts of an advertisement to appear and disappear in varying order. The ordinary illuminated sign has its different letters or parts brought into view or made to change colour consecutively, and when the whole is illuminated it is extinguished to re-appear in the same order as before. The object of this invention is to cause the letters or parts of an advertisement to appear in non-consecutive order, and when complete to be extinguished and re-appear in a different order to the previous one, hence the system has been termed Allaxic, from a Greek compound meaning "always changing," the aim of the inventor being to fix the attention of the observer by the changes in the order of the appearance of the letters or parts of the advertisement. The system is equally applicable for illumination by gas or the electric light; in either case a motor (clockwork, electric, or other convenient form) is employed to actuate a series of switches or valves. The motor shown in our illustration last week is a "Lundell" patent motor, manufactured by Messrs. Veritys, Limited, who are the metropolitan agents for the "Allaxic" system of advertising.

Electrical Engineering in Russia.—A company has just been formed in St. Petersburg, with a capital of 4,000,000 roubles, to be known as the St. Petersburg Company for the Electrical Transmission of Power from Waterfalls. The company intends to put down plant for the utilisation of the Narowa, Imatra, and Wuoxen waterfalls in the generation of electrical energy, and to transmit and distribute the same in the St. Petersburg district for lighting and power purposes.

Gas.—At Eastville, Bristol, on Saturday last, a serious gas explosion occurred, as the result of a bad leakage. The premises in which the explosion occurred were wrecked, and a lady occupant and child were critically injured, and conveyed to the infirmary. The child has since succumbed. Various other explosions, more or less disastrous, have occurred during the week.

"Hansen" Arc Lamps.—These arc lamps, which are made for 1 ampere and upwards for continuous current lighting, and 4 amperes and upwards for alternating current lighting, are being placed on the market by Messrs. Gülich & McIntyre, of 11 and 12, Great Tower Street, E.C., who are the agents for this country. They have just issued a list, giving in tabulated form general particulars, such as current, voltage, &c., of the lamps, and a number of illustrations of various types of "Hansen" lamps are shown together in a middle double sheet. Among the advantages claimed are steady light, a stationary arc, silent working no hissing of carbons, and simple action.

Hill, Gifkins & Co.—This firm, who have just started as electrical, mechanical and hydraulic engineers, have opened offices at 68, Victoria Street, Westminster. Mr. Gifkins, for 10 years, acted as chief engineer and head draughtsman to Messrs. Drake & Gorham, and we understand has superintended for them the erection of such large installations as the Prudential Offices plant for 6,500 lights, and the Army and Navy Auxiliary Stores. He was also responsible for the designing of numerous country house installations. Mr. Hill was the general manager of several important departments of the same firm, including the Jandus arc lamp, D.P. Battery Company, and country and town house lighting. We hear that they have already been intrusted with several important engineering contracts, and they have our good wishes for their prosperity.

Lists, &c.—Mr. R. W. Paul, of Hatton Garden, has brought out a sheet, evidently intended for the wall, giving illustrations, with prices and other particulars, of resistance boxes, galvanometers, scale stands, electrometer, condenser, and several other electrical instruments. At the bottom of the sheet is an 1898 calendar, and some measurement data of service to electrical engineers.

Messrs. H. M. Salmony & Co., of Charing Cross Road, send us one of their 1898 edition lists of electric heating and cooking apparatus, also advance sheets of the electric bell section. In addition to the usual warming and cooking utensils, we notice the electric geyser, electric laundry irons, warming plates for chemical purposes. Numerous illustrations are shown, also prices.

Personal.—Mr. W. Perren Maycock, M.I.E.E., has been appointed writer on electrical subjects to the *British Trade Review*, a monthly journal circulating exclusively abroad.

1897.—In Messrs. Bolling & Lowe's "Trade Review" for the year 1897, the iron and steel trades were in a very satisfactory condition until the middle of the present year, but unfortunately since then the trade of the country has been interfered with by the engineers' strike for an "eight hours' day" with nine hours' pay. "Works were then full of orders, many of which, however, have since been cancelled, as manufacturers were not in a position to carry out their engagements with regard to time of delivery. The harm that has been caused is beyond calculation, and the effects will doubtless be felt for a long time. There now appears, however, to be a prospect of settlement being arrived at in the near future, but before matters subside into their old groove, the result will be great loss of time and capital, directly and indirectly, much of which will have to be borne by the middle-class investors. Probably English capitalists will hesitate to support fresh industrial enterprises at home, and in many instances will prefer to invest in works abroad, which may or may not be competitive, and hence another serious effect of the strike. We have frequent information that companies of all kinds are being started by Continental capitalists for the erection of works in Russia and Eastern Europe (which have hitherto been our customers) and with very good prospects of success; in fact, it has been computed that about £12,000,000 sterling have been employed by them for such purposes during the last two years. Englishmen could hardly be blamed for following the same course, bearing in mind that such enterprises have, as a rule, heavy protective duties in their favour, and no labour troubles. We are often approached upon this subject by correspondents abroad. Light railways are but slowly coming into existence, and the same remark applies to motor cars. Continental countries, in order to relieve their railways from heavy, slow, and expensive traffic, continue to develop their system of canals and waterways, some of which have the additional advantage of being used to produce electric power. We ought, therefore, to continue our efforts to obtain a reduction in railway rates on goods at home."

Mr. G. A. Stienthal, of Bradford and other places, sends us a lengthy list of various installation work which has been carried out by his firm during the past year. This includes the wiring and fitting of many private houses, shops, warehouses, and offices, also public institutions, hotels, mills, &c., in Bradford, Manchester, Harrogate, and other towns.

1898.—From the Eastern Telegraph Company we have received, as usual, a very handy paper-knife with next year's calendar, and maps showing the cable routes thereon.

ELECTRIC LIGHTING NOTES.

Accrington.—The Town Council has on several occasions deferred action in the electric lighting matter until experience has been gained in other places. No one can say that there has been a lack of electric lighting experience in other towns, yet the Council still persists in referring the matter back. Various recommendations, such as proposals for the preparation of plans and estimates for the erection of station, to invite tenders for the plant, and so forth, were before the Council some days ago, but were sent back to the Committee, apparently for further details on certain points.

Bangkok.—In 1892 the Siamese Government took over from the Siam Electric Light Company all their electric light plant, and afterwards the work was carried on by a Government Department. This, however, having proved unsatisfactory, the plant has now been handed over to an American engineer there, who has formed a syndicate of local merchants and others to carry on the lighting. The contract with the Government is to last for 20 years, during which the Government binds itself to use a large quantity of

light, and gives the syndicate the monopoly of electric lighting in Bangkok. The King's palace, some of the temples, the principal streets, and many houses are now lighted by electricity, and under the new and more energetic management the use of it will probably be greatly extended. The present capital is 100,000 taels (£6,000) divided into 100 shares, held by American citizens, British, German, and Siamese subjects; but it is probable, says the *Siam Free Press*, that the capital will be increased to four or five times its present amount, and the syndicate converted into a limited liability company, registered as British. There should then be a good demand there for electrical apparatus. The present plant was manufactured by the Brush Company.

Barrow.—The Local Government Board is holding an inquiry this week respecting the proposed £30,000 electric lighting loan. Particulars have been laid before the Council of the Thwaite-Gardner blast furnace power system, by which it is proposed to utilise the waste heat from one or more blast furnaces at the Steel Works for providing a supply of electricity to the town for light and power purposes.

Basingstoke.—Messrs. Warburg, Dymond & Co. have given notice of their intention to apply for a license, and next year for a provisional order. They have asked for the Council's approval. A committee is considering the matter.

Birkdale.—The District Council has decided to apply to the Board of Trade for a provisional order.

Blackpool.—The *Blackpool Herald* recently contained an interesting comparison of the costs of generating current by the Winter Gardens' installation and the Corporation plant respectively. We reproduce the figures, but would draw attention to the fact that difference in the working conditions of the two installations is not taken into account by the writer. The period taken for the purpose of comparison is the four months from June 1st to September 30th, 1897. To our minds the comparison is most unfair, for the costs mentioned for the Corporation are the average for a whole year, including the light load season, whereas the figures of the Winter Gardens' plant are for four months only—June to September—the Gardens' very best period, when the whole plant is in full swing, and the demand for current greater than at any other time of the year. To be worth anything at all, the Gardens' costs should have been averaged for a whole year, but even then it is reasonable to suppose that the municipal load would be far more variable than that of the Winter Gardens, for the illumination of which, we imagine, a settled number of lamps are continuously in use. The details are as follows:—"Capacity of dynamos, 360 kilowatts; maximum load, 324 kilowatts; number of lamps connected, equal to 8 candle-power each, 21,000. The electricity supplied during the four months was 84,170 units, compared with the production of 429,669 units by the Corporation during one year. The company's electrical engineer points out in his report that had this been supplied to the Winter Gardens Company by the Corporation, it would have cost the former 5d. per unit. The capital expended by the company upon electric lighting plant is put down at £12,000, and the revenue from the supply of current to the company is stated to have been £1,703, besides £49 from the company's tenants, making the total income £1,752. The total cost of production was £440, and allowing £280 for interest and depreciation, at the rate of 7 per cent. per annum upon the capital outlay of £12,000, there remained a net surplus of £1,032 after covering all charges. But it is in the analysis of the cost of generation and distributing that the most striking comparison is made. For instance, for coal and other fuel, cartage, &c., the Winter Gardens spent £178, or at the rate of ·51d. per unit, while the Corporation average is 1·21d. The other items of cost were—Oil, waste, water and engine room stores: Winter Gardens, £19, averaging ·05d. per unit; Corporation, ·40d. Wages of workmen: Winter Gardens, £105, averaging ·30d.; Corporation, ·68d. Repairs and maintenance: Winter Gardens, £15, averaging ·04d.; Corporation, ·48d. Total works' costs: Winter Gardens, £317, averaging ·90d.; Corporation, 2·77d. The respective general costs were—Rents, rates, taxes, &c., £25 —0·7d. per unit; Corporation, 0·11d. Management, salaries of engineers, clerical staff, stationery, printing, and general establishment charges: Winter Gardens, £98, averaging ·27d.; Corporation, ·53d. The total comparative costs for the two departments are—Winter Gardens, 1·24; Corporation, 3·41."

Blairgowrie.—The Improvement Committee is to report to the Police Commission on electric lighting.

Brighton.—At the last meeting of the Town Council the Lighting Committee reported that the loans taken up for street lighting by electricity had been over-spent to the amount of £1,808. Of this sum, £1,070 was accounted for by 17 additional arc lamps and 60 incandescent lamps, £250 by the lighting of Madeira Road, and £670 by the purchase of spare lamp pillars, and lamps and fittings not yet used. The electrical engineer had further reported that the additional expenditure necessary, when the 13 arc lamp pillars in stock are erected, will be £325. It was resolved by the committee that application be made to the Local Government Board for sanction to borrow a further sum of £2,130 for the purpose of street lighting by electricity, the same to be paid by instalments within 15 years. The Committee's action was confirmed.

Bulawayo.—At last week's meeting of the Bulawayo Waterworks Company, the chairman reported:—"With respect to the electric light, I may inform the shareholders that it is installed and has run successfully during the week of the festivities in connection with the opening of the railway at Bulawayo. It will run continuously as soon as the reservoirs are connected with the dams, and we can get a continuous supply of water for the boilers. The charge for electric light authorised by the Government is £2 per hour per light of 16 candle-power. We hope next year to be able to show you actual results of the scheme, which we have every confidence will be a successful one, and we hope it will shortly be completed and be running successfully."

Bury St. Edmunds.—The Town Council have resolved to apply to the Local Government Board for permission to borrow a sum not exceeding £20,000, for the purpose of carrying out the necessary works. Mr. F. H. Medhurst is to be appointed to prepare plans and specifications, and tenders are to be invited.

Buxton.—The Council has informed a private firm that their proposals *re* electric lighting cannot be entertained until Prof. Kennedy's estimate of capital expenditure and working costs for the proposed scheme have been received.

Camberwell.—The County of London and Brush Provincial Electric Lighting Company has given notice of intention to proceed with the work of laying conduits for mains under the pavements of Camberwell Road and other streets.

Cardiff.—The Electric Light Committee is stated to require more water for condensing purposes, the present supply being insufficient, as it becomes tepid through frequent use. The committee asks for a supply from the Ely River. The matter has been looked into by the waterworks engineer, who has issued a report, but a decision has not yet been arrived at.

The electrical engineer (Mr. Appelbee) recently reported that the new plant at the Eldon Road station would be ready for work in a week or 10 days. This would enable the committee to satisfy all the applications for electric lighting in the town.

Chester.—The Town Hall, Free Library, and Public Market are to be fitted and wired for electric lighting. A loan of £2,446 is proposed for the purpose.

Clonakilty.—The Town Commissioners had a brief discussion last week on the subject of electric lighting. A Cork firm had offered to furnish a public lighting plant for £50). The advisability of letting a company come in was considered. A proposal to call in an engineer (travelling expenses £1) to advise, was lost.

Colwyn Bay.—We understand that expert advice is to be taken upon certain matters connected with the proposed electric lighting installation, before the scheme is submitted to the Local Government Board.

Coventry.—The Corporation want an assistant electrician for the electricity works. See our "Official Notices."

Crewe.—The Town Council, on 20th inst., decided to apply for a provisional electric lighting order. The Mayor thought that within a few years an installation would be a paying concern.

Devonport.—The Electric Light Committee has had many names of electrical engineers before it, and has selected four from these. Particulars of the work they have carried out in other towns have been collected.

Douglas.—The Town Council has decided to engage a professional man to report fully with regard to electric lighting, with special reference to the erection and operation of a municipal undertaking, and to advise *re* area, estimated expenditure, &c.

Dublin.—On 8th inst., Mr. Cotton, Local Government Board Inspector, held an inquiry in connection with the proposal of the Corporation to borrow the sum of £20,000 for the renewal of the cables used for the electric lighting of the city. Mr. Macinerney, Q.C., appeared for the Corporation. Mr. Gordon, Q.C., appeared on behalf of the ratepayers. Mr. Macinerney said the application was for a loan of £20,000. Mains had been laid down in certain streets within two years as originally prescribed, and everything went on right until last year, when several break-downs occurred: and those who were skilled in the matter came to the conclusion that those occurrences were due to the wearing out of the rubber used in insulating the cables. The Town Clerk wrote to the Local Government Board for an additional loan, but their answer was that they could not sanction a fresh loan for the renewal or replacing of works executed under former loans which were still current, and that they could only grant a fresh loan for works that were altogether new. Mr. Campbell wrote saying that the work proposed to be done would be all new. The total amount spent on the existing cables was £3,300; and these cables would be available to the extent of about £2,000. No portion of the loan now sought would be expended on anything but what was new; and taking into account the loans already granted which had not all been taken up, and also the proposed loan, there would still be borrowing power of £31,000. Mr. Mark Ruddle, electrical superintendent at the Fleet Street lighting station, deposed in reply to Mr. Macinerney, that the loan applied for was for the execution of new works. The system, in order to keep up with modern requirements, and in order to be worked more economically, must be changed. They proposed to change the whole system altogether. It was the opinion of the consulting engineer, whose services had been authorised to be obtained by the Council, and himself, that the change would be for the benefit of the citizens, and would cause a considerable saving in the working expenses. In dealing with the present supply to consumers, there were difficulties connected with the cables which made it necessary that they should thoroughly repair them. In order to keep up the continuity of the supply they

must keep up alternative mains, and it would not do to interrupt them. To keep up the present supply and effect improvements, they proposed, instead of putting the new cables which would be used in the extended area, which was contemplated for supply purposes, to use them first to continue the supply to consumers and also to improve the system, as a kind of duplicate for a time. For engineering reasons they were bound to keep up the supply and use the new cables to effect that. When they had the new cables, there would be no necessity for continuing the old system, and they would re-lay it in a different way. The total cost of cables, including the first contract and the extensions made, was £3,300. About £2,000 value of that lost would be available in the new system, so that the real loss on the old cables would be £1,300. They would effect a saving in the generating expenses of the old system of supply and would put down low-tension distributing mains in addition to the existing mains. They would give a better supply to the customers and would effect economy. They proposed to extend the supply as the demand grew for it and wished to be in a position to do so. A system of new transformers was to be introduced which would increase the receipts by 15 per cent. Any repairs of the old cables would be done out of revenue. Mr. Gordon said he wished it to be understood that he was not taking up a hostile attitude towards the Corporation. His object was only to get at the facts. It was intended that after the new system should have been introduced the old system would be transferred to other places. The intended works were to be in the same streets that are now supplied. Witness had frequently reported break-downs, and had stated that cables insulated as the existing ones were with vulcanised rubber, could not be depended on for permanent work. An expenditure of £500 would restore them. Witness had reported that the "only remedy would be to replace the whole existing system of cables by some other class of a more reliable construction." The existing arrangements for the supplying of shops with electricity were made at the expense of the Corporation, and would continue to be available. Mr. Kerrigan, city accountant, deposed that after the proposed loan should have been obtained there would still remain a borrowing margin of £31,712. The total of the loans already received for electric lighting was £64,000, of which £58,000 had been expended. The annual profit of the lighting had been credited at £2,025 a year. Of the loans £10,330 had been repaid by half-yearly instalments. In 1891 and 1892 a sum of £6,000 had been taken from the rates. The evidence in support of the application having concluded, Mr. Gordon, Q.C., said the total borrowing powers of the Corporation were about £1,400,000, and it now appeared that they were within £31,000 of the end of those powers, which was perilously near. The existing electric lighting of the city cost £7,000 a year, which was irrespective of the supplies of a great many houses which manufactured electricity for themselves. The ratepayers desired to take care that they would not suffer any loss in this matter. When the Corporation found that they could not get this loan for renewals they adopted an entire change of front. But for the £2,025 a year they would not have been able to repay so much as £10,000 of the previous loans. No depreciation fund had been formed. The new loan was wanted practically to cover loss occasioned by depreciation. They proposed to lay down new and powerful cables, but they had not adequate means of supplying them with electricity. The allegation that the old cables could be utilised to any valuable extent was idle and absurd. Mr. Ruddle had spoken of new work, but what the loan was wanted for was really for renewals. Mr. Cotton said the witness had spoken of what would be a change in the way of distributing the electricity, which was not at all a matter of renewal. Mr. Gordon said if they were to have electric lighting it should be on an adequate and efficient system. His clients did not believe that the Corporation were the best body to secure that; and if a company could do it better it would be the duty of the Corporation not to stand in the way. Mr. Thompson, T.C., was examined and said the whole cables from one end to the other were condemned by the Council. They were told that there would be danger in going on for a month without renewing them. There never was a word about mere "repairs." What was agreed upon was that new cables, according to the very best system, should be laid down. Mr. Macinerney, Q.C., in reply, said there would be an immediate loss to the ratepayers if the loan were not granted, for the intended work would have to be paid for out of the rates. At the end of the present year there would be an addition of £8,000 to the borrowing margin. Counsel submitted that the intended works were not renewals. Mr. Cotton said he would report to the Local Government Board.

East Stonehouse (Devon).—The District Council have had under consideration the matter of overcoming the difficulty arising when the electric light suddenly goes out in the Town Hall, owing to a bearing getting hot or some other defects to their machinery. It was at first proposed to put in the necessary accumulators, and tenders were sent in for this, but as the cost would be nearly as much as that of a duplicate plant, it was decided, on the advice of the surveyor, Mr. A. W. Debnam, to instal a 16-H.P. brake Crossley gas engine and a Newton dynamo of 100 amperes, 110 volts. This was supplied and fixed by Messrs. Lord & Shand, of Plymouth. The result is stated to be very satisfactory. The Council is applying for powers to light the town with electricity.

Electric Lighting at the Houses of Parliament.—During the recess the electric lighting system, which for some time past has been gradually replacing gas, is being extended.

Erith.—Mr. W. C. C. Hawtayne has been asked to prepare an estimate of the cost of lighting the district of Erith with electricity.

Folkestone.—The Council has received from the secretary of the Electric Lighting Company particulars of the proposed positions of the columns for electric light. The arc lamps varied from 64 feet to 86 feet apart, and the incandescent from 40 feet to 46 feet. The standards would be from 18 feet to 20 feet high. The letter also suggested further roads to be lighted. The cost of the columns would be £1,611, and they would replace 200 gas standards, which cost £4 each. The electric lamps would furnish six and a half times the light, at double the cost. The borough engineer is to bring up a report of the number of lamps in the area, and obtain prices from various firms as to the cost of the standards.

Garston.—The Special Committee recommended that 3¼ acres of land at the rear of the Public Offices, Grassendale, be purchased from Mr. G. Bradbury, at a cost of £550 per acre, for use as a site for the proposed electric lighting station and refuse destructor, and for other purposes. There is some opposition in the locality to this proposal, and the Council has decided to hold a special meeting to consider this question.

Govan.—A proposal from the Municipal Electric Supply Company, of London, *re* electric lighting for Govan, has been remitted to the Electric Lighting Committee.

Glasgow.—The new Metropole Theatre has been fitted with an electric light installation by Messrs. Claud Hamilton, Limited.

Harrogate.—The Local Government Board has sanctioned a loan for £15,750 for extending the electric lighting system.

Hastings.—The Town Council held a special meeting to consider a memorial to the Board of Trade on the matter of purchasing the electric light works. The Electric Lighting Committee's report, which was presented, contained a copy of the proposed memorial. This was adopted, as was also the following resolution:—"Resolved that application be made to the Board of Trade for a provisional order, empowering the Corporation, acting by the Council as the local authority under the Electric Lighting Act, 1882, to supply electricity for all public and private purposes within the borough of Hastings, as extended by the Local Government Board's Provisional Order Confirmation (No. 17) Act, 1897, and the Hastings and St. Leonards-on-Sea Electric Light Company, Limited, to sell, and the Corporation to purchase and take, a transfer of the undertaking of the said company, with all powers, duties, &c., conferred or imposed upon the company by the Hastings and St. Leonards-on-Sea Electric Supply Order, 1890, upon and subject to such terms and conditions as have been, or may be, agreed upon between the company and the Corporation, or as may be prescribed by the order, and providing for the revocation of the aforesaid order of the company and the Hastings (Public Purposes) Electric Lighting Order, 1890, or some of the provisions of the same orders respectively."

The Public Lighting Committee having considered the matter of arranging with the Hastings and St. Leonards-on-Sea Electric Light Company for a further temporary continuance of the lighting of the electric lamps on the Front Line, rendered necessary owing to the failure of the contractors for the machinery, &c., for the Corporation's new works at Waterworks Road, to deliver the same within the period originally fixed, the Town Council has resolved that a fresh contract be entered into with the company for a continuance of the lighting during the months of January and February, at the rate of £5 per lamp per month, and (if required) during the month of March, at the rate of £4 10s. per lamp, the charges to include the usual trimming and supply of carbons, which terms the company were prepared to accept.

Hereford.—The Town Council has received a special report from Mr. T. Miller, of Liverpool, upon the scheme for providing electric light in the city. The General Purposes Committee recommend the Council to adopt the estimate furnished by Mr. Miller, amounting to £24,196. Mr. Miller was strongly in favour of the gasworks site.

Horsham.—A member of the Council intends proposing that application be made for a provisional electric lighting order.

Hove.—The electric light has now been installed in the Town Hall. It is 12 months, says a correspondent, since the work was commenced.

Ilfracombe.—The new premises of Messrs. Twiss and Sons are now lighted by electricity. The installation comprises a 10 B.H.P. gas engine, Newton dynamo, and about 100 Ediswan lamps.

Ipswich.—A committee has been considering how to light the new Workhouse. Electricity and gas have both been borne in mind.

Islington.—There was a long discussion at the Vestry meeting about the wages of engine drivers at the electricity works. Here is a specimen of Islingtonian debate:—Mr. Swainson supported the motion, and spoke strongly against trades union rate of wages. Mr. Fuller said if the gentlemen opposite were men of honour, they would support the amendment. ("Order, order.") The Chairman: You must assume that every member of the Vestry is a man of honour. Mr. Fuller (continuing) made an attack upon Mr. Tomkins, and said he would be sorry to show the imbecility of that gentleman. Mr. Tomkins: If I had half the imbecility of Mr. Fuller, I would hang myself. (Laughter.) Mr. Fuller: So much the better for the community. (Renewed laughter.)

Kettering.—Two electric lighting companies have offered to take over the Council's provisional order. The Lighting Committee will consider these offers.

Kingswinford.—The Kingswinford Rural District Council having issued notices of their intention to apply for powers under the Electric Lighting Act for the lighting of districts of Kingswinford and Amblecote with electricity, the Amblecote Parish Council are being joined by the Stourbridge Urban District Council in strongly opposing the granting of the order.

Knottingley.—The Committee of Inquiry appointed by the District Council are seeking advice from electrical engineers and taking steps to obtain information with regard to the practicability and cost of lighting the public lamps by electricity.

L.C.C. and Electric Lighting.—At last week's meeting, the L.C.C. discussed a report of the Fire Brigade Committee with reference to the proposal to light part of the brigade headquarters, Winchester House, by electricity. Sir John Hutton did not think electric light was the most economical, and it was undesirable. Col. Ford said the Council had gone on all these years without it, and they could continue to do so. [If this argument were applied to all the Council's undertakings, how much progress would be made?] The Committee's recommendation was, however, agreed to.

Liverpool.—A sub-committee of the Tramways Committee is to confer with a sub-committee of the Lighting Committee with regard to utilising the trolley poles of the tramways for electric lighting.

Lowestoft.—Mr. W. C. C. Hawtayne has prepared a report for the Lowestoft Town Council as to the advisability of putting down works for a combined electricity supply and destructor. Dealing with the question of cost, he estimates it at £20,000 without a destructor, and £22,400 with a destructor. He recommends 6d. per unit be charged for lighting, which would be equivalent to gas at 3s. per 1,000 cubic feet. This would bring in a revenue of £3,950, thus allowing a gross profit, after working expenses are paid, when 8,000 lamps are used, of £1,652 19s. per year, which, after repayment on capital and interest at 5½ per cent., would leave a profit available for the reduction of the rates of £585 9s.

Marylebone.—The Board of Trade have received notices of three applications for competing provisional orders for powers to light with electricity the area comprised within the parish of St. Marylebone. The applications have been made by the Vestry, by the Marylebone Electric Supply Company, Limited, and by the County of London and Brush Provincial Electric Lighting Company.

Middlesbrough.—The Electric Lighting Committee has conferred with Mr. R. Hammond, and settled upon the compulsory area of electric lighting.

Newquay.—The order for the electric lighting of the Hotel Victoria, which is in course of construction, has been placed with Messrs. Drake & Gorham. The installation will comprise over 400 lamps, the generating plant being two gas engines, which will work in conjunction with a battery of the D.P. Company's latest central station type cells.

Paisley.—Mr. Teague has reported that Messrs. Callender and Co. have laid 7,001 yards of high tension main, 5,490 yards of low tension, and 6,134 yards of arc lighting main, including the pilot wires between the works and the Cross.

Partick.—The Glasgow Electricity Committee, and representatives of the burgh of Partick, have been conferring with a view to opposing the application of the Kelvinside Electricity Company for a provisional order including the Partick district.

Plymouth.—The Electric Lighting Committee recently reported that tenders were received for the erection of the electricity works at Prince Rock, and, it appearing that the amount of the lowest tender was largely in excess of the sum included in respect of such works in the estimate upon which the loan sanctioned by the Local Government Board was based, they referred it to the chairman, the borough surveyor, and the electrical engineer, to endeavour to devise a scheme which would materially reduce the cost of the works, and to report to the committee thereon at the earliest possible date, and that, meanwhile, the further consideration of the tenders be deferred. It was also reported that only one tender was received for the construction of underground transformer chambers; and the recommendation was, that the work be carried out by the Corporation. Mr. Debnam said the lowest tender for the proposed works was considerably in excess of any money the Corporation had to spend. The committee, therefore, set about to see how the estimate could be cut down, and he was pleased to inform the Council that, by eliminating from the plans and specifications that which was merely ornamental, a saving of £3,000 could be effected. The intention of the committee was, if possible, to get the electric light into working order by next winter. The committee's recommendation was adopted, and they were empowered to accept a tender.

Portsmouth.—A Local Government Board inquiry was held on Tuesday in respect to an application from the Corporation for permission to borrow £21,000 for electric lighting purposes. Mr. G. Ellis, J.P., chairman of the Electric Lighting Committee, said that at present there were five boilers at the electric lighting station, all of which are being used continuously, with the result that the insurance inspectors had not been able to make the usual examination this winter, although they had certified the boilers up to next April. It was impossible to erect any more boilers in the present buildings, and therefore it was proposed to build a new boiler house and chimney shaft. Four new boilers were wanted, with some duplicate apparatus, and new condensing apparatus. On the three roads in which mains were originally laid down—King's Road, Palmerston Road and Commercial Road—the light had been taken up by the inhabitants so readily, that the mains had become overcharged, and there had been a consequent decrease in the pressure, so that it was absolutely necessary to lay additional mains. The rest of the loan was wanted for house services, meters, and contingencies. Their position as a trading concern was satisfactory. On March 31st last year they started with a deficit of £2,715, due to the interest and sinking fund, which accrued during the construction of the work. On March 31st last, after having paid all the expenses of working, maintenance of plant, interest and sinking fund, the deficit had been reduced to £391. Since then loans had been granted to erect new engines, but unfortunately the strike of engineers had prevented their erection, and therefore the revenue would be less than the estimate, although it would be ample to meet all the requirements. The profits last year were within a fraction of 8 per cent. on the capital expenditure. Mr. Manville, consulting engineer, stated that the additional boilers would double the capacity and boiler power of the station. It was necessary to have one spare boiler, which there was not at present. Replying to the inspector, Alderman Ellis stated that they had had to refuse 1,000 would-be customers up to date, and the electric lighting was already paying its way. The committee would have a surplus, although not so large as had been expected. In addition to the difficulties caused by the strike, the committee had had to hire machinery in order to get through the Christmas work, and had reduced the price to 4½d. per unit.

Rosario.—The lighting of the city of Rosario for the year ended June 30th, 1897, was carried out by means of 245 arc lamps and 732 gas lamps.

Rotherhithe.—A letter was read at a meeting of this Vestry on Tuesday week, notifying the intention of the County of London and Brush Provincial Electric Lighting Company to apply to the Board of Trade for a provisional order in respect to the parishes of Bermondsey and Rotherhithe, and the districts of Greenwich and Lewisham.

Rothesay.—The Town Council has decided to apply for a provisional order for electric lighting, and Mr. T. Crichton Fulton, of Glasgow, has been appointed engineer. Mr. Fulton's report has been before the Council, and of the schemes proposed, it was agreed to apply for the scheme to light up the harbour, esplanade, and from the Aquarium to Argyle Place, and inquiries are to be made at private houses on the route as to the number who would use the light. The cost of the public and private proposal would be about £6,600, and for the public lamps alone £1,800.

Rowley.—The Midland Electric Corporation for Power Distribution has given notice of its Stafford and Worcester scheme for electric lighting and power distribution to the District Council, as this is one of the districts to be supplied under the Bill.

Sedgley.—The application of the Electric Corporation to supply the district with electricity has been referred to a committee.

Sheffield.—A special meeting of the City Council was to be held on Wednesday, when Mr. H. W. Chambers (chairman of the Parliamentary Committee) was down to move:—"That, in accordance with the recommendation of the Parliamentary Committee, application be made to the Local Government Board for a provisional order amending so much of the Local Government Board's Provisional Orders (No. 9) Act, 1892, as will enable the Corporation to issue irredeemable stock to an amount sufficient to raise the purchase money required for the purchase of the undertaking of the Sheffield Electric Light and Power Company, Limited, under the powers conferred by Article 60 (1) of the Sheffield Electric Lighting Order, 1892." This means, says the *Sheffield Daily Telegraph*, that the Parliamentary Committee are accepting the decision of Mr. Justice North, and propose to get out of the difficulty created by his decison by obtaining powers to issue irredeemable stock. It is understood that concurrently with this application negotiations will be re-opened with the Electric Light Company to arrange terms of purchase.

Spain.—We have on numerous occasions stated that when tenders have been invited for electric lighting concessions in Spain no offers were forthcoming. Various reasons have been put forward to account for this. A correspondent at Madrid now sends us a newspaper cutting which, he thinks, may explain "the reason why in some tenders in Spain few tenders are handed in." We recently announced that tenders were wanted for the electric lighting of Guadix, Province Granada. The *Correspondencia de Espana* says "Several householders of Guadix have presented a petition to the Governor of Granada, begging for a force of the civil guard in order to avoid the attacks of a band of robbers who infest the place every night." Surely electric lighting is just the thing required for Guadix to keep these robbers at a distance. There seems to be plenty of room for the Spanish army to be of service to its country at home whatever it may do in Cuba.

Stirling.—The Lighting Committee is to obtain a report from Prof. Kennedy as to the utilisation of water pressure at Touch or elsewhere for electric lighting.

Stockton.—The District Council had before it last week proposals *re* dust destructors, also electric lighting. A deputation is visiting various places mentioned by the borough engineer, where dust destructors are employed, including Shoreditch.

Tunbridge Wells.—The electric light is being laid on at the Wellington Hotel, Tunbridge Wells, by Mr. J. Jarvis.

(*Continued on page* 903.)

ELECTRIC TRAMWAYS IN DUBLIN—CLONTARF SECTION.

The Clontarf section of the Dublin Tramways Company, Limited, which has recently been electrically equipped from the city boundary (Annesley Bridge) to Dollymount, serves a suburban district studded with residential villas of a superior class.

The track throughout takes the line of the sea coast at the opposite side of Dublin Bay to that on which runs the electrically equipped line of the above company from Dublin to Dalkey. At the Dollymount end of the line are situated the famous golf links of the Royal Dublin Golf Club, which are largely patronised all the year round. The total length of the newly equipped line is slightly under 3 miles of double track, the gauge being 5 feet 3 inches (which is the Irish standard), and the system of equipment being that of the overhead trolley.

The power house, which is situated at the Dollymount end of the line, is erected on a site previously used by the tramway company as stables and car houses, the buildings then existing being altered to suit the present requirements.

It has been erected from plans supplied by the British Thomson-Houston Company, Limited, the building works being carried out by Mr. R. O'Connor, of Mount Street, Dublin, under the direction of the Dublin Tramways Company's engineer.

The power house, including car and repair shops, covers a space of 166 feet × 140 feet.

It is divided up into boiler house, engine house, repair shop, offices and car house, the latter being capable of accommodating 26 motor cars.

In the boiler house are installed three boilers of the Babcock & Wilcox type.

The main flue, which runs along the front of the boilers, is lined throughout with fire-brick; the gases can either pass directly through to the chimney, or by a bye-pass through the economiser to the chimney.

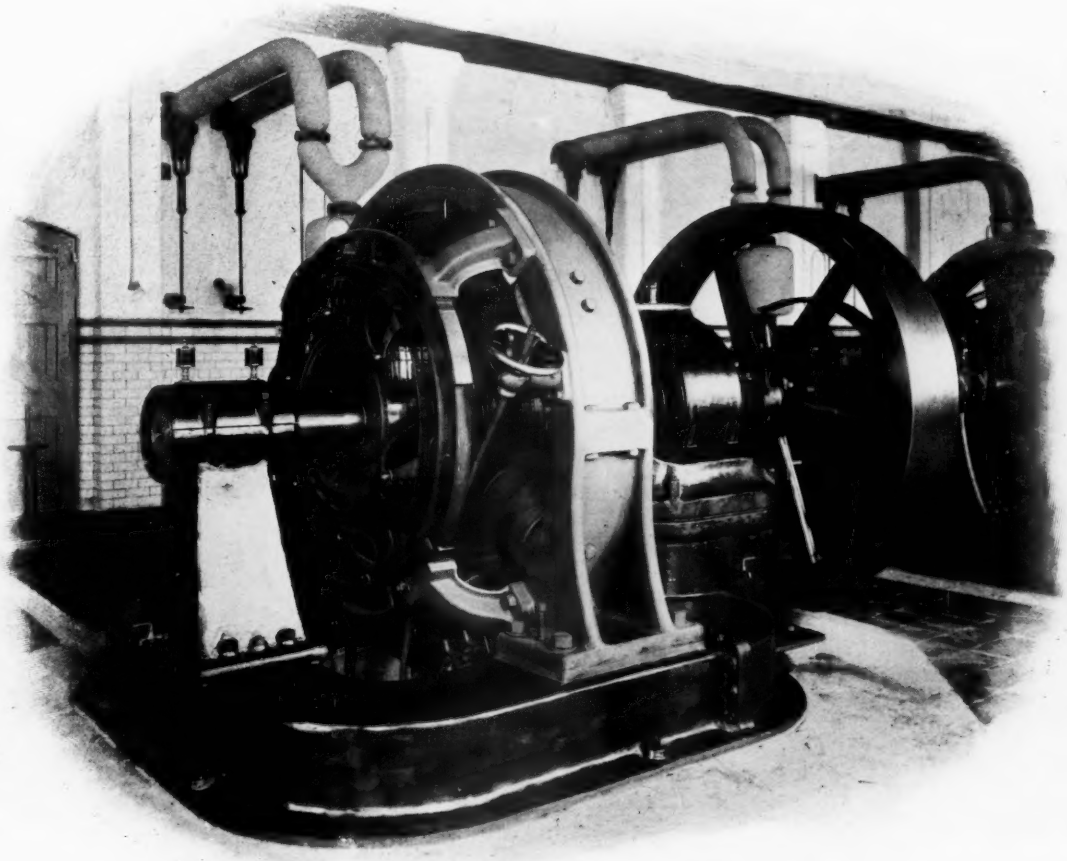
The chimney is built octagonally, the inside diameter is 7 feet, and the height to the top from the ground line is 112 feet. There is a fire-brick lining from the floor level of the main flue to a height of about 50 feet.

Each boiler has a total heating surface of 2,197 square feet with a grate area of 44 square feet. The steam and water drums are constructed of mild steel plates. There are two drums to each boiler, which are cross connected.

A Green's economiser, consisting of 160 tubes, has also been erected in the boiler house. This is of standard pattern. Water is supplied to the boilers by two direct acting horizontal Worthington steam pumps, each being capable of delivering to the boilers 22,000 gallons of water per hour against the full working boiler pressure (150 lbs.). A cast-iron water tank, with a capacity of 10,000 gallons, has also been erected in the boiler house, but in view of the possibility of the supply not being sufficiently constant from the township, a storage tank with a capacity of 38,000 gallons has been excavated on the company's land immediately adjoining the engine house.

The feed water and steam piping is in duplicate throughout; the former is of cast-iron, and so arranged that the supply can be taken from either water tank direct to the boilers, or through the economiser.

The steam range, in duplicate, is of lapwelded steel pipes with cast-steel flanges; from these branches are taken to the boilers and engines.



View of Generator.

The requisite number of valves are provided, so that either range may be worked independently of the other.

On each engine is fitted a steam separator, this being placed immediately over the main engine stop valve.

The engines—three in number—built by McIntosh and Seymour, are horizontal tandem compound, and are directly coupled to six-pole 150 kw., 500-volt, 200 r.p.m., British Thomson-Houston Company's generators.

The length of stroke of engine is 17 inches, the diameter of the H.P. cylinder being 11½ inches, and that of the L.P. 23 inches.

Both cylinders are provided with valves of the piston type, of standard form, these valves being provided with a patent adjustable seat for preventing leakage.

The seat consists of two rings made in one piece, and connected by several bridges across the port openings which the space between them forms.

The field frame and magnet cores are of steel, the latter being removable without disturbing the field frame or armature.

The coils are wound on separate forms, so that they can be readily slipped on and off.

The brush-holders are supported radially, and are constructed with end play, to admit of uniform wear of the commutator.

These generators are designed so as to deliver an overload of 25 per cent. above their rating for two hours without heating; they are also capable of sustaining sudden fluctuations up to 50 per cent. above their rating, and down to zero, without injurious sparking at the commutator, and without shifting of the brushes.

The switchboard is of the British Thomson-Houston Company's standard form and construction, there being one complete panel for each generator, containing the necessary

View of Car Sheds.

All the bearings on these engines are lined with babbitt metal, hammered in and bored out.

The generator armatures, which are drum-wound, have special ventilating ducts and highly laminated cores, the laminæ being individually dovetailed into the spider supported from the shaft, and insulated from each other by means of high grade japan coatings.

The windings consist of interchangeable copper bars, set into slots in the periphery of the core, insulated all over with layers of special paper and mica.

The end connections of the armature windings are in one piece with the body of the winding, and lie upon the circumference of the same cylinder.

The inner surface of the end connections are protected by a metal flange from the spider extending laterally to support these end connections. The commutator is of hard drawn copper, insulated with mica.

switches and instruments, including an automatic circuit breaker of the magnetic blow-out principle, quick-break switches, &c.

Each feeder panel is designed for two circuits, and contains circuit breakers, and an ammeter for each circuit. There is also a total output panel, with Thomson recording wattmeter, and a leakage panel in accordance with the Board of Trade requirements.

The lights in the power house are supplied from a British Thomson-Houston Company marine type generating set, consisting of a high speed vertical engine, coupled direct to a four-pole 10-kilowatt generator, running at 656 revolutions per minute, the lighting being by arc and incandescent lamps.

An overhead travelling Jessop & Appleby crane of 6 tons capacity runs the whole length of the engine house.

The lifting and travelling gear is arranged to be worked by hand from the floor.

There are two main feeder cables looped at intervals into a switch pillar.

Each of these switch pillars contains six quick-break switches.

These switches are so arranged that any section of the line or feeder may be cut out without interfering with any of the other sections.

The switch pillar also contains a magnetic blow-out lightning arrester, which is connected to the trolley line.

The overhead line construction, which is on the span wire system throughout, is erected in the following manner.

The poles, 29 feet 6 inches in height, are built up in three sections of 5 inches, 6 inches, and 7 inches best quality tubular steel, made with over-lapping joints shrunk together while hot.

This type of pole has been specially designed to sustain the strains incidental to the operation of an overhead trolley system while containing a minimum amount of metal.

They are spaced at an average distance of 120 feet.

built to accommodate 54 passengers, of whom 25 are carried inside.

These cars are similar in most respects to those in operation on the tramway company's Dublin and Dalkey section. The cars are lit electrically, and are mounted on trucks of the Peckham cantilever extension type.

These trucks are mounted on 33-inch wheels. The springs supporting the car body consist of four elliptics, and 12 coil springs so combined and graduated that the weight of the car comes first upon the elliptic springs, and as the load increases the spiral springs come into play.

The brake beams are of the best quality wrought-steel bars, the leverage being 10 to 1.

The shoes are so constructed as to be interchangeable and easily removed without loosening any bolts.

Each truck is also fitted with an adjustable life and wheel guard at either end, which can be adjusted to any desired height from the track.

The electrical equipment is as follows :—The trolley pole

View of Line and Jetty.

There are two trolley wires throughout composed of No. 0 B. and S. gauge hard drawn copper wire divided up into half mile sections.

The track, which has been relaid by the Dublin United Tramway Company with a 7-inch girder rail, has been efficiently bonded with Chicago 4/0 × 30-inch bonds. It is also cross bonded at short intervals.

There are no grades or curves of any note throughout the entire length of line, and there is only one point where there is any variation in the height of the line over the track, this being where the track passes under a railway bridge; here the line is dropped from 21 inches to 17 inches.

The existing and new tracks in the car shed and repair shops have all been wired, so that the cars may be moved electrically to any desired location.

Fifteen motor cars have been equipped for this service, 12 of the bodies having been built by Milnes & Co., Birkenhead, and the remaining three by the Dublin United Tramway Company; they are exceedingly roomy, and are

and base is of the swivelling arm type, the wheel is mounted on a pivot fitted so as to prevent its catching in the span wire; it also has a special arrangement for bringing the wheel back into line, should it come off the wire.

This wheel is so constructed that, should it wear through, the rims will not drop off. The trolley pole is of light steel insulated by means of braiding, the pole in its turn being insulated from the socket.

The socket is on a pivoted base, and supplied with ball bearings; the electrical connections between the fixed and rotating part is of such construction that the cables cannot be twisted off.

There are two main motor switches, one at either end of the car, one of these being designed to act as an automatic magnetic blow-out circuit breaker.

The controllers are of the British Thomson-Houston K 2 series parallel type, and embody the magnetic blow-out principle.

These are fitted with an interlocking arrangement, by

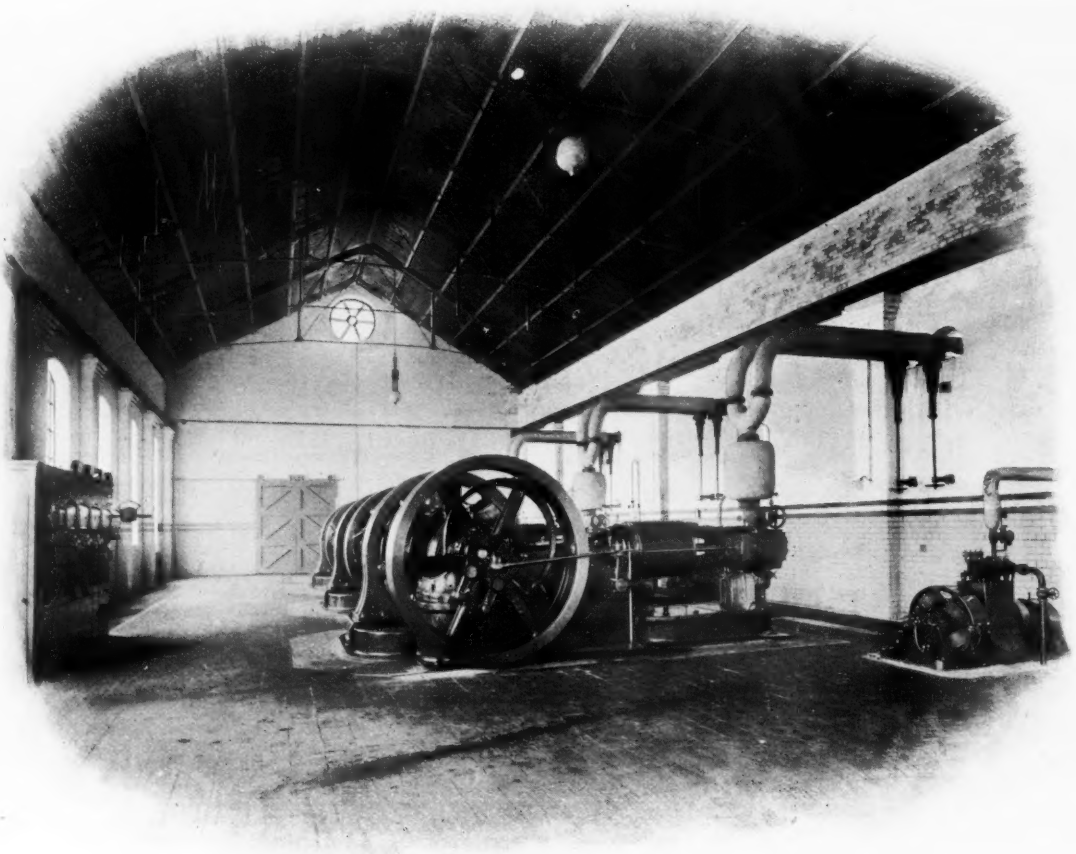
which the power handle cannot be moved, except when the reversing handle is set to run either forward or backward.

The reversing handle is so designed that it can only be removed at the "off" position.

These controllers also contain an emergency stop switch, whereby the car can be very quickly stopped, owing to the braking action effected by so connecting the motors that they become, for the time being, generators. This emergency stop is entirely independent of any extraneous source of electricity supply. The motors are of the well-known G E-800 type, there being two motors on each truck.

It is proposed to extend the line from Dollymount to the seaside resort of Howth, a distance of about six miles.

Ample room has been left in the power house for future extensions, the plant at present installed being capable of working the line from Clontarf to the city.



Dublin.—Interior of Station.

THE WORKS OF THE GENERAL ELECTRIC COMPANY AT SCHENECTADY.

By H. C. GUNTON and H. LOMAS.

This great company was founded five years ago by the consolidation of the Thomson-Houston Electric Company, of Lynn, with the Edison General Electric Company.

To-day they are the biggest manufacturers of electrical machinery in the world, turning out work from three factories at Lynn, Harrison and Schenectady; it is with the last, and most important, of these with which we have to deal.

The Schenectady Works.

Schenectady is situated on the main New York Central and Hudson River Railroad, about 14 miles from Albany and 165 from New York, in the State of New York; owing to the enormous quantity of work turned out, which includes electrical machinery and appliances of widely differing kinds, and the fact that whole departments are devoted to the manufacture of articles which most electrical manufacturers buy outside, it is beyond the scope of this article to describe every department in detail, but we propose to take the reader through the larger workshops, which afford some idea of the complexity and magnitude of the work carried on. Throughout the works every facility is afforded for the rapid transit of goods; within the shops themselves overhead, travelling electric cranes rapidly convey castings from place to place. Outside a trolley system is employed to transport machines in various states of development from shop to shop, and when the machine is finished, it is swiftly transferred to its destination by the New York Central or the Delaware and Hudson railroads, which have sidings within the yard.

Coming to the consideration of the shops in detail, we take first the main machine shop where the castings are brought from the foundry to be machined. This is built in three bays; the centre is served by two overhead electric cranes, and in the side bays work is transported from machine to machine by overhead travellers run on rails suspended from beams.

The machines, principally housed in the side bays, are driven by countershafting off two main lines of shafting, an illustration showing the Edison bipolar motor driving the shafting. In some cases the bigger machines, notably one or two in the middle bay, are driven by their own motor; for example, the 120-inch planer shown, and also two vertical slotting machines, the casting to be machined being fixed and the foundation plate of the machine so arranged that

the whole machine, including the G.E. 800 railway motor which drives it, can be adjusted about a vertical axis.

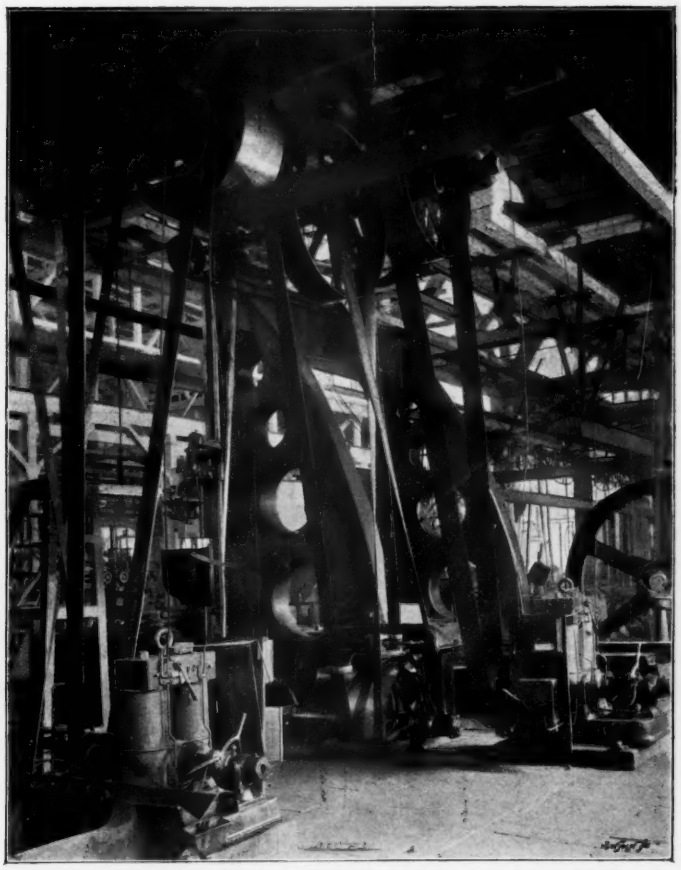
In direct contrast to this is a machine for turning up large commutators and field yoke rings, or boring out pole-pieces, the casting in this case being clamped to a plate which revolves about a vertical axis, and the tool being stationary.

A portion of this shop is devoted to the bearings; these are all of babbitt metal, self-oiling and self-aligning.

Immediately across the road is an overflow workshop largely used for railway work, this kind of work is gradually being transferred from Lynn to Schenectady in accordance with the policy of the General Electric Company of centralising their work at Schenectady.

The railway motor is now so well known that little description is necessary; the sizes most in demand are the G.E. 51, G.E. 1,200, and G.E. 800, they are rated on the basis of a rise of temperature of 75° C. after an hour's run, and on this rating are of 80, 35, and 27 H.P. respectively.

They are all four-pole machines enclosed in steel water-proof and dust-proof castings, hinged at one side and bolted at the other. The field coils consist of asbestos covered wire wound on special formers. After winding, the coil is first wrapped with canvas strips and then immersed successively in oil and japan, and afterwards baked.



25-H.P. Edison Bipolar Motor driving 120-inch Planer.

Commutator and Armature of 500-kw. Railway Generator.

The armatures are of the slotted type with Eickemeyer winding, the core discs being punched from well-annealed sheet-iron, and then annealed a second time after punching to remove the hardening effect consequent on that operation. Naturally enough, to punch out all the discs for these and other armatures, a considerable number of punching machines are required, and, in fact, a whole shop is devoted to them, the plates being punched and also japanned in the same shop by passing them between rollers covered with some special material.

The shafting in this shop is driven off two induction motors of 30 H.P. each, the terminal voltage being 110, power is generated at 1,000 volts, transmitted on a bare copper conductor for a mile at 30,000 volts and then transformed for use to 110.

The installation was made purely for the purpose of gaining actual experience on transmission at such high voltage. It has been up over a year and experienced all weathers, the result of all insulation tests being eminently satisfactory.

The armature winding shop is another big department, all the different kinds of armatures turned out are wound here, monocyclic armatures with the two windings, main and "teaser," which will be described later, large alternators, with stationary and moving armatures, railway generators and motors, induction motors, &c.

A breakdown voltage test is applied to the coils as they are wound, for example, in the case of a drum or ring wound armature, an iron core on which a primary coil is wound, is placed over the armature in such a way that a part of the armature winding lies in the field so created. The armature is then slowly rotated so that

every coil comes in turn into the "primary field," then if any of the armature coils are short-circuiting each other, the secondary current consequently induced will burn out the faulty section.

A machine when completed is conveyed to the testing room in which every appliance is at hand for thoroughly testing every kind of machine. It it built in three bays, the centre being provided with two cranes, and it is usual to erect machines in this bay.

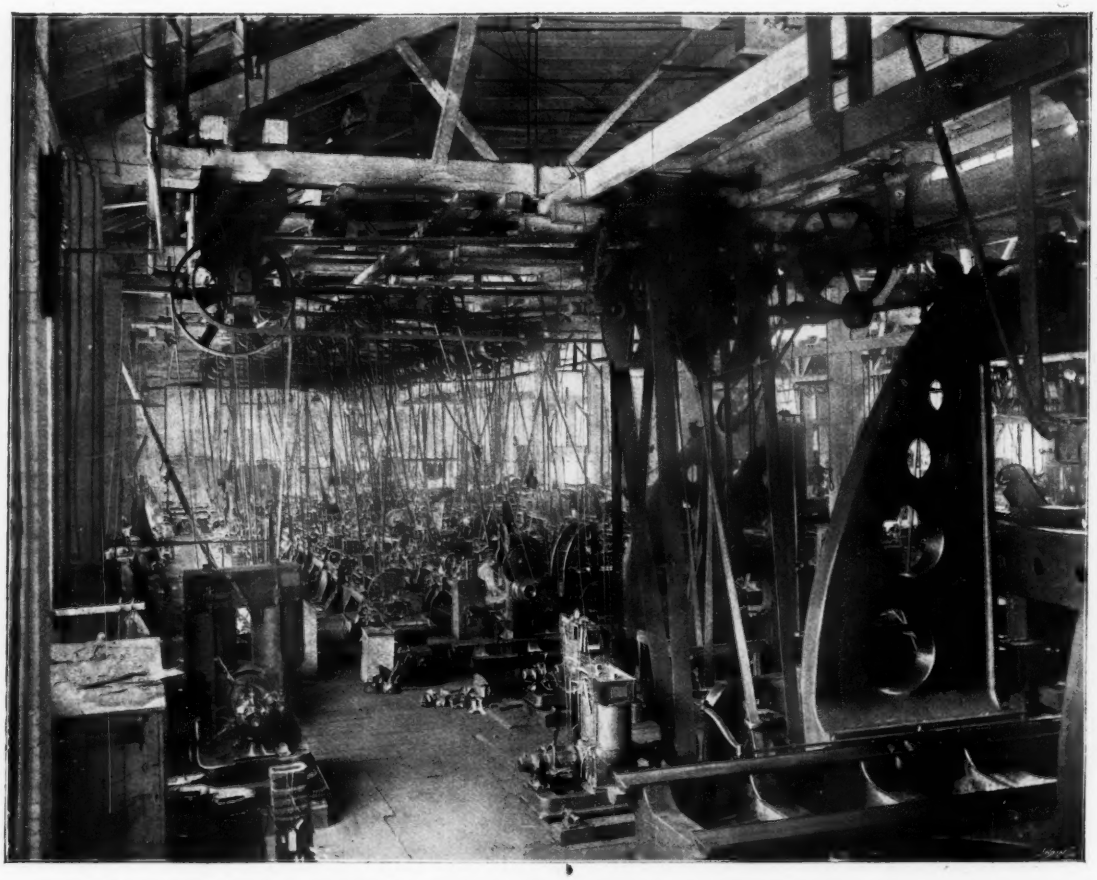
Convenient testing appliances are at hand, along one of the side bays a countershaft runs belted to a four-pole motor supplied from the power house, the shaft is fitted with pulleys and clutches, &c., to which machines can be connected.

Outside the building there are a series of water rheostats adjustable from inside, and load is put on a machine either by this means or by making them restore power, either through the countershaft or by an electrical method such as Kapp's; in addition switchboards are erected on the pillars supporting the middle bay from which the various necessary voltages can be obtained.

Small direct-driven sets for isolated plants are also tested here, and consist of double-acting vertical engines direct-coupled to four-pole machines. The engines vary from 2½-inch stroke and 3½-inch cylinder diameter generating four kilowatts at 800 revs. up to 8-inch stroke and 10-inch diameter developing 25 kilowatts at 305 revs., the valve, which is of the piston type in a single cylinder engine, receives its motion from an eccentric pin on the fly-wheel, the pin being arranged so that increase of speed increases the pressure of a fly weight which reduces the eccentricity of the pin, and, consequently, the motion of the valve; this governor is capable of changing the cut-off from ¾-stroke to 0, and has very few moving parts.

Another portion of the testing shop is given up to induction motors, the type most in use being the single phase or three-phase. The standard frequency adopted is 60 cycles per second, though for use on mono-cyclic circuits high frequency motors of 125 cycles per second have been manufactured. In all cases the rotor is the secondary, the coils being either short-circuited or wound so that a resistance can be inserted in series with the armature which prevents excessive current on starting, this resistance revolves in the armature spider, and is cut out through successive steps by means of a short-circuiting switch mounted on a collar which slides along the shaft; moving the collar up towards the armature cuts out the resistance.

The starting resistance is designed to give a maximum torque 50 per cent. greater than the running torque. Sizes under 5 H.P., where a large starting current is not too objectionable, are supplied if required without starting resistance.



Edison Bipolar Motors Driving Shafting.

All machines are subject to high potential insulation tests, 500-volt machines being tested at 5,000 volts, and 10,000-volt machines at from 30,000 to 50,000.

The tested machines are conveyed direct by crane to another shop (the middle bay girders of the two shops being continuous for this purpose) where they are painted, packed, and shipped, the railway siding running right into the building. Room is also found here for testing railway motors, the machines being connected in pairs, one running as a motor and driving the other as a dynamo for one half of the test, this arrangement being reversed for the latter half.

It may be readily imagined that all these various processes require a good deal of power. To supply this there is, in addition to a 1,000 H.P. engine in this shop, which may either be used for testing direct coupled or for supplying power to the testing department, a separate power-house supplying current on the three-wire system at 250 volts across the outers for the lighting circuit and the motors driving the shops, and also current at 550 volts direct and 1,000 volts

alternating. The above power-house is being supplemented by a transmission of power from Mechanicville, which is some 18 miles distant from Schenectady, by means of which 2,000 H.P. will be supplied by three-phase currents at 12,000 volts, rotary converters giving 250 volts at their direct current side being installed in the Schenectady power-house. Other departments there are too numerous to mention, as, for instance, the porcelain making department, and a building in which copper wire is both rubber-insulated and braided, the rubber being bought in the raw state and worked up for use.

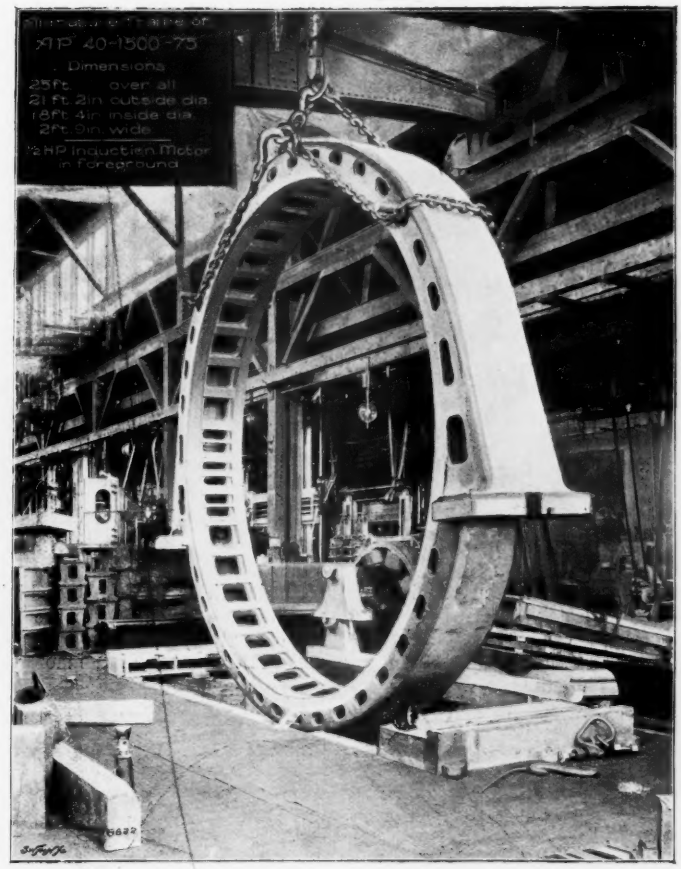
No account of these works would be complete without reference to the standardising department. Here every instrument used in the works is tested at least once a week.

The standard instruments in use are a Kelvin ampere balance, standard ohm, and standard cells. These are periodically checked against each other and other standards.

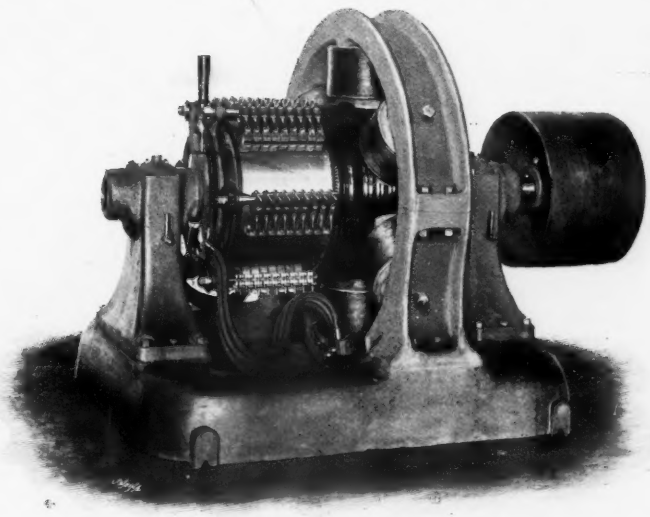
Owing to the facilities so kindly placed at our disposal, the writers were able to gather some very interesting information with regard to the mono-cyclic system, which was introduced by the General Electric Company in order to operate induction motors off single phase mains. It will be remembered that the mono-cyclic generator is essentially a single phase machine provided with an extra "teaser" winding, one end of which is connected to the centre of the main winding.

This teaser winding generates a current with a phase difference of 90° from that of the main winding, and of one-fourth the voltage.

Fig. 1 shows diagrammatically the arrangement of the coils, and fig. 2 is the diagram of E.M.Fs. The mains taken from the points *b* and *c* form a simple single phase system; the main from the point *a*, known as the teaser wire, being used simply for the purpose of starting motors. Now, it will be seen from fig. 2, that if the E.M.F., *a c*, is reversed in direction as shown as *a* c^1, we obtain a three-phase system of E.M.Fs., *a* c^1, c^1 *b*, *b a*, 120° apart.



Armature Frame of 1,500-kw. Three-Phase Generator.



100 kw. Belt-Driven Lighting Generator.

This re-arrangement is carried out in practice by means of two transformers arranged with regard to the mains as shown in fig. 3, the secondary winding of one of the transformers being reversed. The teaser winding only supplies current when a motor is being started up, that is, until the counter E.M.F. of the motor has risen to the same value as the E.M.F. impressed by the teaser winding. In the mono-cyclic generator the current through the teaser is very large when the motor is being started and decreases as it is run up; thus, since the current adds itself more or less directly in one leg and subtracts itself in the other, very good regulation can be obtained by placing the compounding coil in the former leg.

In the case of transmission of power to a considerable distance, it is not necessary to run a teaser wire from the generator to supply the displaced E.M.F. for starting motors. This can be obtained from a three-phase induction motor which is kept running off the single-phase mains. Owing to the three-phase winding on the armature, the back E.M.F. of the motor will be three-phase and the reaction between this three-phase back E.M.F. and the single-phase impressed E.M.F. results in a three-phase E.M.F. at the field terminals, by means

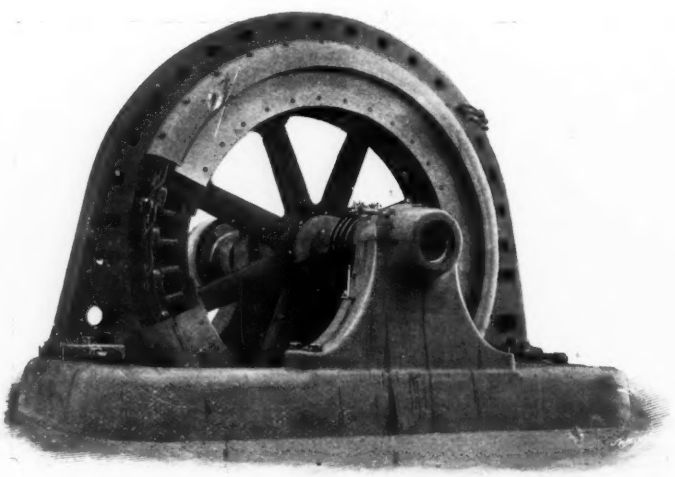
of which all the other motors on the system may be started.

Another device employed by the General Electric Company for starting induction motors off the single-phase mains consists of a self-inductive coil placed in series with a non-inductive resistance across the single-phase mains.

From the junction between the reactance and the resistance a third wire is taken to the motor terminals. On open circuit, at the motor terminals, the E.M.F. between the junction and either of the mains is out of phase with the E.M.F. of the latter.

On the motor drawing current from the third wire, this out of phase E.M F. is reduced and, on the speed increasing, is finally equalled by the back E.M.F. of the motor.

To prevent further waste of power, the starting device is at this point cut out from across the mains.

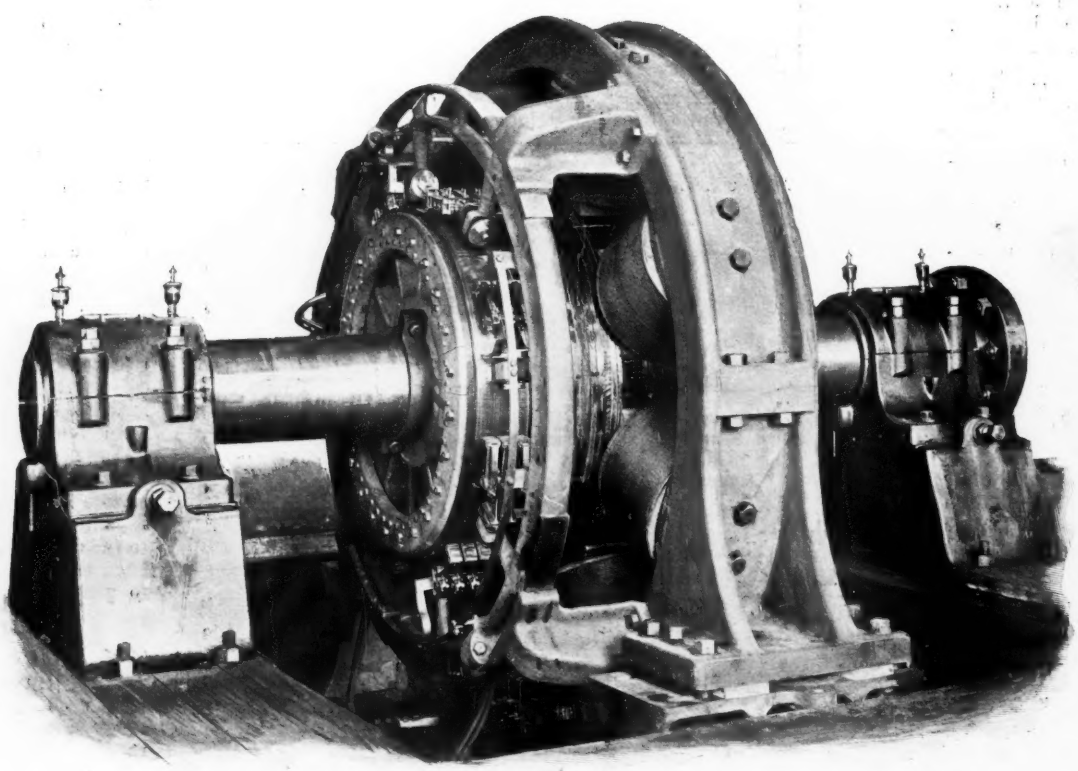


750-kw. Three-Phase Generator, 40 Poles, 175 r.p.m.

A machine which the General Electric Company have quite recently developed on a commercial scale is the rotary converter, which is finding so much favour at present, in connection with transmission schemes. At Brooklyn, for instance, it is intended to do away with several small lighting stations and run one large central station which will include three-phase machines generating current at 6,600 volts. Current will be transmitted at this pressure to sub-stations where it will be stepped down to 80 volts and passed through converters which will feed from their direct current side into the three-wire network. They are also being used in connection with the Edison Illuminating Station at Chicago.

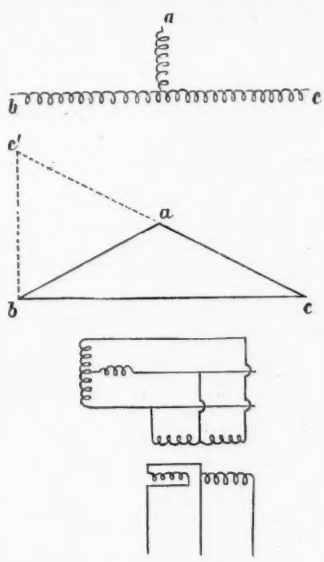
A rotary converter system of this kind possesses very good regulation which is attained in the following manner: — The converters are compounded and the strength of their field adjusted so that on an increase of load their back E.M.F. is higher than the impressed, which causes the current in the line to lead. Now, a leading current increases the magnetisation of the generator, and decreases that of the motor, so that by careful adjustment a very perfect regulation can be obtained, without having a series winding on the generator.

These converters are started up in different ways, according to the surrounding conditions.



300-kw. Direct-Driven Railway Generator, 550 Volts, 8 Poles, 91 r.p.m.

Usually, they are run up to speed without any starting device or separate excitation, the re-action of the armature sufficing to excite the field. Sometimes they are provided with an induction motor carried on an extension of the shaft. Again, when direct current is available, they may be



Figs. 1, 2 and 3.

speeded up as continuous current motors, before using them, to convert from alternating to direct current.

Before closing this article the writers wish to express their thanks to Mr. C. P. Steinmetz, and other members of the staff of the General Electric Company, who gave up much of their time in showing them round the works.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 894.)

Wakefield.—At the last Council meeting it was explained that the delay in the lighting of the streets with the electric light was in consequence of the dispute in the engineering trade.

Walsall.—The Streets and Electric Lighting Committee have been conferring together with reference to a proposal to erect a dust destructor at Wolverhampton Street. They have resolved that at the present time it is not expedient to incur the cost of providing thermal storage for the electricity generating station in connection therewith, but that arrangements should be made in erecting the destructor that the waste heat from it may be used for generating steam for the electric lighting station, in the event of its being found desirable to do so at some future time.

West Ham.—The electrical engineer reports that the work under the various contracts in connection with the electric light installation are in a very satisfactory condition. The engineer's estimate for wiring the various public buildings on the route of the electric light mains is £2,841.

Weston-super-Mare.—The District Council is to raise an electric lighting loan of £20,000. The Council is drawing up its objections to the syndicate's proposed scheme.

Whitehaven.—£7,500 is wanted for electric lighting extensions. This sum includes £1,000 for two new boilers, as it is thought that those now at the station should be replaced. The Electric Light Committee recommends that experiments be made with arc lamps for street lighting. It is thought arc lighting will compare very favourably with the incandescent system now in vogue at Whitehaven.

Wigan.—A letter has been received by the Gas and Electric Lighting Committee from the British Insulated Wire Company, Limited, stating the terms on which they would be prepared to take over the Wigan Provisional Order for Electric Lighting. A special meeting of the committee will be held on Tuesday, January 18th, to consider the question of electric lighting generally.

Yarmouth.—The receipts for electric current for November showed a surplus of £260 17s. 11d. over the working expenses, to meet capital charges of £190 per month, about the best result yet attained. There are now 423 customers using 11,760 lamps. Messrs. Crampton's free wiring offer is not to be entertained, the surveyor and electrical engineer being directed to frame a scheme for the Council to carry out.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—A special meeting of the Town Council was held on 20th inst. *re* the Parliamentary Bill about to be promoted, one of the aims of which is to obtain powers to run electric trams along the new middle promenade at North Shore. Mr. Kingsbury moved that this part of the scheme be struck out altogether. Others declared that the scheme would add to the attractiveness of the town. The amendment was defeated by 12 votes to 5. The town clerk said the Bill must have 13 votes in favour, whereupon the opposition was withdrawn. This was done in order that the ratepayers shall have the opportunity of considering the scheme.

Calcutta.—The Calcutta Corporation has resolved to give the tramway company an opportunity of repairing the lines and using electricity in place of horse-power.

Chatham and District.—The parishioners of New Brompton, Kent, have voted unanimously in favour of the proposed electric tramway scheme for Chatham, Rochester, Gillingham, and district.

City and South London Electric Railway.—A rumour which has been in circulation as to a proposed purchase of the above underground railway by the Brighton and South Coast Company, is flatly contradicted by Mr. W. F. Knight, secretary of the City and South London Company.

The *Clapham Observer* says that on Wednesday last week there was a breakdown, blocking the line for half an hour in the morning.

Colombo.—Colombo is to have electric tramways on the overhead wire system. The work of laying the lines and building the power station is just being commenced.

Croydon.—It is stated, says a correspondent, that a large majority of the shareholders in the Croydon Tramways Company have agreed to sell the undertaking and assets of the company to the British Electric Traction Company, Limited, at a price which will pay off the preference capital at par, and will return 60 per cent. to the holders of ordinary stock.

Electric Carriages.—Mr. H. J. Dowsing, M.I.E.E., gave a lecture on Saturday week, at the Public Buildings, Ealing, before a large and enthusiastic audience, on "Electricity as a Means of Motion." He first introduced his subject by drawing attention to the fact that there was a close relationship between the motion of heat and electricity, and illustrated this by means of a Cox thermo-pile, showing how readily it was transformed into electricity. He then explained the electrical properties of a current passing through a wire, introducing the electro-magnet, and, finally, describing the construction of the electro-motor. The lecturer stated that these motors were in use with great success in large works and private houses; but, perhaps, the most interesting use of the motor at the present time was for locomotion. The various systems used in electric traction, of overhead trolley, the underground conductor, and storage, were then explained and illustrated with various models, and a large selection of views was shown on a screen illustrating electric and other motor carriages.

Electricity for the Underground.—The Metropolitan Railway Company have deposited their Bill for next session in the Private Bill Office of the House of Commons. One of its six parts takes power for the company to work by electricity the whole of the traffic on their railway, or on any part of it, including the lines held jointly by them and the Metropolitan District Railway Company. For this purpose it is sought to erect a generating station on land adjoining their Edgware Road station, and power is also sought to enter into agreements with the Metropolitan District Railway Company with reference to the working of both systems by electrical power. No new capital powers are sought under this Bill.

Highgate Cable Tramway.—The Highgate Hill Cable Tramway broke down late on Saturday night last, owing to the giving way of a large wheel in an underground chamber at the top of the hill. On this wheel the endless cable which drives the whole of the cars turns, and when the wheel broke the traffic ceased altogether. The cars at the bottom of the hill at the time of the accident had to be drawn up to the depôt by horses, the work taking over six hours.

Isle of Thanet.—The Margate Town Council has received a communication from the Light Railway Commissioners with reference to the application made by the Isle of Thanet Light Railways Company, sending draft of an order they proposed to make. A committee is considering the draft, in case any observations have to be made regarding it, the latest date being January 1st, 1898.

Kirkcaldy.—The Tramways and Council Committees have been discussing the proposal to introduce tramways into the town, and have almost unanimously approved of the idea, also of the employment of the overhead electric trolley system. A sub-committee was appointed to get a report from an electrical engineer on a combined electric lighting and tramway scheme.

Leeds.—On account of the engineers' strike, Messrs. Greenwood & Batley have been delayed in the execution of their contract for the electric cars. They have been interviewed by a Corporation deputation, who are anxious to have the cars delivered, and Messrs. Greenwood & Batley have undertaken to push them forward with all speed.

Large Electric Train.—The *Pittsburg Post* recently gave an illustration of the largest train ever moved by an electric engine. This was run some time ago in the State of Ohio, on the Akron, Bedford, and Cleveland Railroad, which is an electrically-equipped line, about 25 miles long. The train was composed of 11 Pennsylvania passenger coaches, including a baggage car. The train was an excursion train, and each passenger coach carried 125 people. This enormous weight, it is said, was pulled around a curve up a 4 per cent. grade by a single electric locomotive, which was equipped with four 50-H.P. motors made by the Westinghouse Electric Company.

Light Railways.—The London and South Western Railway Company, on Thursday week, received the order from the Board of Trade authorising the construction of the Basingstoke and Alton Light Railway.

The proposal of Messrs. Massingham & Co., electrical engineers, to construct a light road railway at Taunton, using electricity as the motive power, is still engaging attention locally. A deputation, consisting of the Mayor of Taunton and other local gentlemen, who were supported by Sir C. Rivers Wilson, Sir C. Freemantle, and a representative of the London Chamber of Commerce, waited upon the Board of Trade some days ago to discuss the merits of the scheme, which had already formed the subject of a local inquiry by the Light Railway Commissioners, when the chairman (the Earl of Jersey, G.C.M.G.), assisted by Colonel Boughay, R.E., and Mr. Fitzgerald (barrister), expressed the opinion that they could not grant the powers sought on the ground that they had no jurisdiction; but Sir Courtenay Boyle and Sir Thomas Bloomfield, of the Board of Trade, are of opinion that powers might have been granted under the Light Railways Act, and, as a result of the conference, the President of the Board of Trade (Mr. Ritchie) decided to refer the whole case to the Law Offices of the Crown.

The Middlesex County Council will oppose the Finchley, Hendon, and District Light Railways Bill, by which it is proposed to connect Hampstead, Hendon, and Finchley by a light railway, the whole length being about nine miles. The promotion of the light railway scheme through Acton, Ealing, and Hanwell has been abandoned.

Manchester.—It is stated that the Moss Side District Council will oppose the Manchester Tramways Company's Bill, which seeks powers for using electricity on Moss Side Tramways.

The opposition is only raised in order to give the Council a *locus standi* to protect the ratepayers' interests.

Motor Dust Carts.—The Public Works Committee of the Wolverhampton Corporation is advertising for designs and tenders for motor vans, the intention being to employ these vehicles for street scavenging and for the removal of refuse. It is stated that preference will be given to vans in which electricity is the motive power.

Portsmouth.—At the last meeting of the Council, Alderman G. Ellis, chairman of the Electric Lighting Committee, proposed a resolution authorising the promotion of a Bill in Parliament for the acquisition, re-construction, and working of the tramways. He dealt with the statistics relating to corporate working of tramways in other towns, and contended that the undertaking should be acquired by the Corporation in the interests of the public. Alderman Sir John Baker, M.P., prophesied a most prosperous future for the undertaking when in the hands of the Corporation. The resolution was carried by 48 to 2. The Bill was afterwards formally approved.

Preparation of Track.—Several mishaps have been reported this week from Glasgow and Kidderminster in connection with the preparation of roadways for the electric tramways. Openings made by the contractors seem to have been left insufficiently fenced, or not protected at all, and accidents have arisen which have resulted more or less seriously to pedestrian and vehicular traffic.

Sheffield.—For the appointment of chief electrical engineer to the Corporation, to work in conjunction with the city surveyor in the construction of the electric tramways, the Corporation has selected Mr. A. Llewellyn Fell, who is at the present moment resident engineer for the British Thomson-Houston Co., in the equipment of the Cork electric tramways. His salary will be £400 per annum, rising £25 per annum to £500. There were forty applicants for the position.

Southampton.—At a recent meeting of the Town Council, Alderman Lemon moved that a committee be requested to invite designs, and estimates for motor vehicles for the carting of house refuse. He said he wanted Southampton to come to the front, but at present he only asked that information be obtained with regard to the motors. Electric traction was cheaper than horse traction. The motion was agreed to.

Staffordshire.—The British Electric Traction Company propose including from Queen's Cross, Dudley, to Cradley Heath, in the application for a provisional order.

Warwick.—A syndicate having offered to take over an extension of the tramways lease with a view to employing electric traction, the matter has been considered briefly by the Town Council. Further consideration of the proposal has been deferred.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephone Service.—It was mentioned at the meeting of the Brighton Town Council last week that a committee was considering the desirability of the Corporation acquiring the telephone business in the town. It was decided to join other governing authorities in an attempt to secure an alteration in the existing law which, it is contended, gives the Post Office Department undue advantage by permitting it to grant easements over roads to telephone companies, thus debarring local authorities from opposing such concessions as they would have opportunity of doing if companies had to apply to Parliament.

Direct Cable Communication to the West Indies viâ Bermuda.—The surveying steamer, ss. *Britannia*, has returned from the West Indies, after having found a suitable bed for the new cable to Jamaica. The ss. *Scotia* left the Thames on Monday morning for Bermuda, with the cable on board, which has been manufactured, without a hitch, by the Telegraph Construction and Maintenance Company, Limited. The new cable forming another of the links in the Imperial chains of communication over entire British territory, binding together the mother country and her colonies, is expected to be laid and opened to the public on January 31st next. Hitherto messages to the West India Islands and British Guiana were sent *via* the United States and Cuba, thus passing through foreign hands, but when the cable is laid from Bermuda to Turk's Island and Jamaica, messages can be sent *viâ* Bermuda over entirely British territory, thus securing to them the advantage of transmission by British subjects only, and avoiding their being handled by foreign competitors in trade. The Direct West India Cable Company, who own the new cable, are reducing the rate to Jamaica by 3s. 10d. a word, or nearly 50 per cent., and at the present time this will be a great boon to the West India merchants, and will help to stimulate trade.

Huddersfield Telephones.—The Huddersfield Town Council has decided to give notice to the National Telephone Company to remove all telephone poles, wires, &c., erected by them at Longwood.

New Mutual Telephone Company.—A meeting in support of the movement to establish the new Mutual Telephone Company for Manchester and district, was held some days ago in the offices of the Chamber of Commerce, Manchester. Mr. W. Thomson presented a report, on behalf of the directors, of the progress made since the movement started. At the time of the last meeting they had obtained promises of support to the extent of £30,000. Since then about £30,000 more had been secured. He did not think it would be advisable to float the new company until they had got a still larger amount of capital promised, because they were treating these promises of support to some extent as an underwriting. The promoters felt that most of the capital should be subscribed in Manchester so that they should be able to control their own destinies. They proposed to float the company at the end of January, or early in February next year. He had been told that recently there had been a great improvement in the National telephone service. He thought such improvement could be attributed to the attempt to float another company in Manchester, and he would caution them against imagining that the improvement would be continuous if the idea of a competitive company were abandoned. They had been asked to start a similar company in London, and had received substantial promises in the matter of capital. It might be assumed that they would favourably respond to the appeal. In that way they would be able to join two very important exchanges. It was intended to register the Manchester Company with a capital of £250,000. The £60,000 already subscribed was sufficient to put the scheme in operation, but the directors considered that their position would be greatly strengthened if, when they went to the Post Office, they were able to say they had obtained all the capital.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Otranto-Vallona	Oct. 11th, 1897 ...	...
Vigo-Borkum	Nov. 28th, 1897 ...	Dec. 17th, 1897.
San-Thomé-Loanda	Dec. 13th, 1897 ...	...
Saigon-Thuanan	Dec. 20th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

The Telegraph Wire Export Trade.—November proved to be a very quiet month as regards the exports from this country of telegraph wire and apparatus connected therewith. From £46,127 in October last, the exports for November declined to only £34,341, as compared with £48,371 in the corresponding month of last year, and £70,459 in November, 1895. For the 11 months ending with November last, the aggregate shipments have, however, amounted to £828,962, as against only £748,276, an increase of £80,686.

CONTRACTS OPEN.

Bilbao.—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Bedford.—January 10th, 1898. The Electric Light Committee want tenders for the supply and erection of a 420 B.H.P. double-acting compound enclosed engine, and a 250-unit alternator with stationary armature. See our "Official Notices" December 10th for particulars.

Bootle.—January 10th, 1898. The Corporation wants tenders for the supply and erection of boilers, engines, dynamos, switchboard, pumps, transformers, wiring, alteration of Town Hall wiring, batteries, mains, street boxes, and the running of the electricity works for three years. Consulting engineer, Mr. T. L. Miller, 7, Tower Buildings, Water Street, Liverpool. See our "Official Notices" December 10th for further particulars.

Glasgow.—The Clyde Trust is considering a comprehensive scheme for the lighting of the Quays. For the lighting of the Queen's Dock it is proposed to use between 30 and 40 arc lamps. The lighting of the Cessnock Dock Works area is also being considered.

Gloucester.—January 18th. The Electricity Committee want tenders for boilers, dynamos, overhead crane, switchboard, accumulators, mains, arc lamps, meters, &c., for electric lighting. Consulting engineer, Mr. Robert Hammond. See our "Official Notices" December 10th.

Italy.—December 30th. Tenders are being invited by the Municipal Authorities of Catanzara, for the construction of a tramway between the centre of the town and the railway station, to be operated either by electricity, steam or cable.

Leicester.—January 31st. The Leicester Corporation invites designs and tender for motor vehicles for the collection of house refuse. Specifications and particulars, with drawings, to be sent to the Chairman of the Sanitary Committee, to the office of Mr. E. Geo. Mawbey, C.E., borough engineer, Town Hall, Leicester.

Morley (Yorks.).—December 31st. Tenders are being invited for the supply and fixing of lightning conductors to various buildings at Bridge Street Board Schools. Particulars from the Clerk to the Board, School Board Offices.

Newcastle-on-Tyne.—December 27th. The trustees of Heaton Road Wesleyan Church invite tenders for the installation of the electric light in their church, lecture hall, vestries, lobbies, &c., with front and side door lights. Tenders to be sent to J. W. Hunter, 170, Shields Road.

Roumania.—December 31st. Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of 25 tons of galvanised steel wire for telephone purposes.

Roumania.—March 15th. Tenders are being invited by the General Direction of the Roumanian Post and Telegraphs in Bucharest for the supply of 56,000 metres of galvanised iron and steel wire.

Shoreditch.—January 11th. The Vestry want tenders for wiring materials for one year. Particulars can be seen at the Lighting Engineer's Office, Town Hall.

Singapore.—December 31st. The Municipal Commissioners are inviting tenders for the lighting of street lamps for a period of five years. Particulars from Mr. C. C. Lindsay, 167, St. Vincent Street, Glasgow, or the secretary to the Municipal Council.

Southampton.—January 1st. Tenders are being invited from local firms for the electric wiring and fitting of the electricity supply station, Back-of-the-Walls, Southampton. Engineers, Messrs. Kincaid, Waller and Manville.

Spain.—December 27th. The Municipal Authorities of Utrera (Seville province) are inviting tenders for the concession for the electric lighting of the town and surrounding district during a period of five years. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Seville).

Spain.—The Secretary of State for Foreign Affairs has received a despatch from her Majesty's Chargé d'Affaires at Madrid, transmitting copy of a Royal Order inviting tenders for the construction and working of a telephone system in Tarragona. Sealed tenders will be received at the office of the Civil Governor of the province of Tarragona for 40 days, counting from the 11th inst. Further particulars of the conditions of the tenders may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Spain.—January 9th. The municipal authorities of Torrente (Valencia province) are inviting tenders for the concession for the electric lighting of the town during a period of 17 years. Tenders to be sent to El Secretario del Ayuntamiento de Torrente (Valencia).

St. Pancras.—December 28th. The Vestry wants tenders for the supply and erection of "arc lamp posts and circuits complete," also feeding and distributing mains. Particulars from the chief clerk to the electricity department. See our "Official Notices" December 3rd.

FORTHCOMING EVENT.

1897.
Tuesday, December 28th.—The Royal Institution. The first of a series of six Christmas lectures (juvenile) on "The Principles of the Electric Telegraph," by Dr. Lodge, F.R.S.

NOTES.

Christmas Greeting.—We have great pleasure in cordially wishing all our friends—readers, contributors, and advertisers alike—a very merry Christmas. The year has been a busy one for most electrical men, and they will be ready to start the new year with a determination to regain the ground lost to them by the strike, which, unfortunately, gives but little promise of coming to a speedy termination.

Another American Invasion.—According to Tuesday's *Pall Mall Gazette*, a preliminary prospectus is being privately circulated of the proposed White and Middleton Gas Engine Company, Limited. The idea of the company is to erect a works at Colchester, in which district there is abundant and cheap non-union labour, and to exploit for the European markets the patents of Messrs. White & Middleton, engineers, of Baltimore, U.S.A., for a gas (or oil) engine, which, it is claimed, is very simple in construction and working, and can be sold at a considerably less price than leading British gas engines, such as those of the "Otto" type. One main feature of the White and Middleton engine is, that it is applicable to the use of either gas or gasoline, and it is stated to have carried off medals and other awards in the States, in the competitions with the "Otto" gas engine. It should be noted, however, says the *Pall Mall*, that in the States coal gas is much dearer than in this country, and that therefore American engineers will use gasoline and other highly inflammable and dangerous oils, which show them a great saving in working, but which users of gas engines on this side generally would not touch. Moreover, on calling the attention of a leading gas and oil engine expert to the specifications accompanying this preliminary prospectus, our contemporary's representative was assured that, unless these particulars were "duffers"—that is, disguised or incorrectly showed some of the essential details of construction—there was nothing in the engine which was not already equalled in those produced by even second-rate British makers. In any case, the business proposed by Messrs. White & Middleton on this side—the United States and Canadian patents are excluded—is obviously in the nature of a speculation; and intending investors should thoroughly satisfy themselves as to the merits of the engine, which is on view at 39, Queen Victoria Street, E.C. The capital of the company is to be £200,000, of which the vendors take one-third in ordinary shares in part payment of the consideration for the patents (£140,000); leaving £60,000 for the erection of the works at Colchester, and other contingencies.

Obituary.—We regret to learn of the death of Mr. Walter H. Brownlee, who was for about four years electrical engineer superintending the Dundee Corporation electricity works. He was only 29 years of age, and leaves a widow and one child.

"A Daniel Come to Judgment."—Nothing is too ambitious for the young Emperor William of Germany. Epic poems, allegorical paintings, soul-stirring speeches, religious expeditions to the East, great navy schemes, are, with various other ideas too numerous to mention, among the offspring of the fertile brain of this so accommodating emperor. A great poet, a celebrated artist, a world-renowned orator, a theological Don Quixote—to attain to one such eminence has generally satisfied most men who have laboured in any one of these directions. But this German phenomenon despises the day and men of small things, and would combine the talents of a universe bringing them to the aid of his kingly office. He would be one and all. But what fills us with such terrible awe in the presence of his majesty is the statement that he is coming to the rescue of electrical men. He will lay aside for the time being his brush and palette, will hold the Muses in abeyance, will stable his Rozinante, forget the sound of martial music, and in a serious manner sit down to devise an electric tramway system such as no man ever invented before him. We learn that it has been left to him to decide what system of electric traction shall be adopted for Berlin; but it is highly probable, we are told, that he will not select either of the systems already propounded, but will, *if he has time*, invent a new one. The principal difficulty seems to be the want of time; but if we may, without being guilty of treason, suggest anything, we should think that a whole army of poets, artists, prophets, and admirals might be found ready to bow the knee and relieve him of his other duties for the time being, so that his entire genius could be concentrated upon a matter which has, to a certain extent, baffled electrical engineers of life-long experience of all nations and tongues up to the present time. A capital idea would be for the Emperor to purchase for a few marks some patent or other from one of his starving subjects, and whether he understands it or not, to give it his approval. Then, whether it is good or bad, who in Germany will dare to criticise it? It *must* be favourably received by the Press and the public, or the results——! We are tempted to wonder whether the Emperor's system will be a trolley or conduit; or, it may be, he will bring out a new accumulator—or, perhaps, even a primary battery!

Electric Wiring.—A report has been made by a London County Council Committee to the effect that Covent Garden Theatre in its present condition is unsafe for the purpose of fancy dress balls. One of the several reasons for this statement is, that certain joints in the electric light wires are unsoldered. It is understood that the County Council's electrical engineer was on the premises many times during the progress of the work, and it is stated by the theatre officials that all the fittings had been passed by inspectors of 24 fire insurance offices. The fittings also are said to have been passed by the Council's engineer as safe in the first instance. It was only on December 17th that the L.C.C. wrote referring to the unsoldered joints, and a day after the receipt of this, men were engaged putting them right. Whatever the exact circumstances of the case may be, it is certainly very gratifying to find that the officials of the L.C.C. have their eyes open to the evil effects which might result from the use of unsoldered joints. That these joints were passed as safe is by no means a compliment to the fire insurance inspectors. The L.C.C. will do very good service if it continues the supervision of public electric lighting installations in this way. The dangers of unsoldered joints were referred to at length in evidence given at the Law Courts a fortnight ago. With the present tendency to compete for house wiring at prices which will not allow of first class workmanship and material, it seems that about the only way to ensure perfection in private houses is to have lighting jobs rigorously supervised by men who know what should or should not be put in.

Wireless Telegraphy.—Signals have been successfully transmitted from the station of the Wireless Telegraph and Signal Company at the Needles to Swanage, a distance of at least 16 miles. The receiving apparatus was on board a tug, and messages were transmitted between the boat and the station up to the distance between the Needles and Swanage Pier.

The Earth's Potential Gradient.—Measurements of the potential of the earth's atmosphere appear to indicate that the earth has a permanent negative charge, which has been calculated by Le Cadet to amount to about − 160,000 volts. The equipotential surfaces near the surface of the earth follow its contour, so that they crowd closer together over the tops of mountains, and the potential gradient there is consequently steeper. The potential at any point in the air is measured by a flame or water-dropping collector and an electrometer, and can be easily and exactly measured when the place is within reach of the ground. To determine the potential gradient in the higher regions of the air, balloons have to be employed. Two-flame collectors are suspended at a known difference of level from the car of the balloon, and the difference of potential between the two points is measured by a suitable electrometer. Börnstein has recently pointed out (*Wied. Ann.*, Vol. 62, p. 680) that there is a source of error inherent in this method, due to the presence of a charge of electricity on the balloon itself. At the moment of starting, the balloon is charged to the same potential as the earth, and this charge it carries with it as it rises through the air. The gradient due to the balloon's charge will be superposed on that due to the earth, and what is measured is really the sum of these two. By measuring the potential at three equidistant points below the car, Börnstein has shown that this charge on the balloon has a considerable effect on the measurements, and that the charge on the balloon is reduced by leakage as it ascends. If A, B and C are the potentials at the three equidistant points below the balloon, r their mean distance from the electrical centre of the balloon, and M the charge on the balloon. Then $\frac{d^2 V}{d\ r^2} = \frac{2M}{r^3}$; d^2 V being equal to (A—B)—(B—C).

Personal.—Mr. Justus Eck, M.A., M.I.E.E., managing director of Messrs. Laing, Wharton, & Down, Limited, left New York on 22nd inst. on his return journey to this country, having spent about two months in the United States on the above company's behalf, studying the latest developments in electric traction and street railway work. He has visited New York, Buffalo, Cleveland, Maguire, Chicago, Boston, Hartford, New Haven, Philadelphia, St. Louis, Milwaukee, Pittsburg, Cincinnati, &c.

Electrolytic Copper in Russia.—The *Engineering and Mining Journal* abstracts a recent article in *Elektrochemische Zeitschrift*, by Dr. Rostin, on this subject. The first works in which electrolysis was applied was that of Messrs. Siemens and Halske, at Kedabeg, in the Caucasus. Later, Nikolajev established works at Nijni-Novgorod, and recently Rosenkranz has made an installation at St. Petersburg. Nikolajev began operations seven years ago, and at present is producing about 15,000 poods of electrolytic copper a year, 1,500 poods of tin (recovered from tinplate scrap), 2,500 poods of antimony, 1,500 poods of white lead, and 6,000 poods of various by-products, among the last being pure nickel, which is obtained by a private method from nickel iron. In the copper department there are 70 vats arranged in cascade form. The process employed has certain novel features which have been developed in these works. The volume of current employed is generally 45 amperes per square metre. A tenor of 0·003 per cent gold, or 0·1 per cent. silver in the material treated, is said to cover the entire cost of the electrolysis. Such material is very frequently obtained, especially from the Caucasus and Verkhne-Isetsk. Besides electrolytic copper, the Nikolajev works produces copper directly from matte by the Marchese method, which has, however, been significantly improved. The average grade of the copper matte treated at these works is 26·6 per cent. copper, 46·2 per cent. iron, and 13 per cent. sulphur. Antimony is recovered from old antimony alloys and nickel from nickel iron, the pure nickel produced from the latter assaying 99·8 per cent. The production of white lead is carried on by a secret process, which is probably not very different from those of Tibbits, Thénard and Swinburn. Cement copper is also produced in a department of the Syrjanov works at Smjeinogorovsk. Electrolytic parting of gold and silver has been carried on for a considerable time at the Imperial Mint at St. Petersburg.

Brixton en Fête.—The Electric Avenue at Brixton is a veritable fairyland. Thirty charming festoons of evergreens are stretched from side to side at short distances apart, and from these, peeping out here and there, are 300 incandescent electric lamps, cunningly encompassed with coloured drapery. Arc lamps—and such steady-going lamps—alternating with Christmas trees, are fixed at four or five yards apart, along each side of the Avenue to the number of 100, and a similar number is used for the interior lighting of all the shops. Two gigantic trees, each decorated with 30 incandescent lamps, stand sentinel-like at the Brixton Road entrance, one guarding the Bonanza and the other Parke's Drug Stores. The genial manager of the first-named huge emporium of the good things of this life will probably have much to answer for, for what mortal could resist the temptations to over-indulgence here displayed during the festive season; but, luckily, the cure is on the opposite side of the way, and drugs will be in great demand later on. Gibraltar and Malta, as these establishments are familiarly dubbed, are evidently necessary to each other's existence. Electric Avenue and its central station are owned by Mr. John Fyfe, of Aberdeen, who has done much for the business folk of Brixton; and to Mr. Christie, the engineer in charge, is entirely due, we believe, the credit of transforming a bustling, busy, crowded thoroughfare into a perfect wonderland of electric lighting, which everybody should make a point of seeing.

The Magnetic Needle in Russia.—The *Standard* correspondent at Moscow says:—"The results of the investigations made by the French *savant*, M. Moureau, and Russian scientists into the extraordinary deflection of the magnetic needle over an immense area of Central Russia have still to be published in scientific form. Meanwhile a few general facts may prove interesting. Observations were taken over a strip of country between Moscow and Kharkov, or extreme points, N. and S., distant from one another, as the crow flies, about 850 miles. The greatest aberrations are found in the province of Kursk, the capital town of which is some 600 miles almost due south of Moscow. In the northern part of the province, near Tim, the needle deflects 20° further south, in the district of Staroi Oskol up to 30°, while in the south-east of the province, about 150 miles south of Tim, the deflection is over 96°, the needle standing almost perpendicular, and pointing east and west, instead of north and south. A number of new railway lines are in process of building over this part of the country, and it will be most interesting to railway engineers to follow the probable effects of this magnetic force on the durability of steel rails, which, in places not specially magnetic, are known to last much longer when laid north and south than when they run in any other direction, the line of most wear and tear from magnetisation being, of course, due east and west." This last sentence may be taken as a fair example of newspaper science.

Retirement of Mr. H. C. Fischer.—Mr. Henry Charles Fischer, C.M.G., Controller of the Central Telegraph Office, London, retires from the service in February next, after an honourable career of 44 years. Mr. Fischer commenced his telegraphic life in the service of the Hanoverian Government in 1853, and in 1856 joined the Electric and International Telegraph Company. There he held the position of superintendent of their foreign branch, and afterwards of their central office in the City. At the transfer to the State in February, 1870, he was appointed controller of the central office, a position which he has held ever since. Mr. Fischer, by his intimate knowledge of the minutiæ of telegraph business, was of great assistance to Mr. Scudamore in the gigantic task of the transfer referred to, and during his service he has seen the introduction of duplex, quadruplex, and multiplex telegraphy, and a great development in the speed of Wheatstone, working from 70 words per minute simplex to 400 words duplex, on long distance wires to Aberdeen and Plymouth. Mr. Fischer was appointed a Companion of St. Michael and St. George in the New Year Honours of 1896. The staff under his direct control numbers over 4,000 persons, male and female, the salaries, wages, and allowances, of which amount to £400,000 per annum. The salary of the office Mr. Fischer vacates is £1,000, with a personal allowance of £100 per annum additional.

Electric Light Accident in Dublin.—Some few weeks ago a note appeared in our columns stating that a man had received a severe shock from coming in contact with the base of an arc lamp-post. The borough electrical engineer, a week later, ridiculed the idea that the shock was due to electricity. However, the man seems to have been so decided, that he brought an action against the Dublin Corporation for injuries sustained through the alleged negligence of the defendants in their control of the city electric lighting system. The plaintiff's evidence showed that on October 30th last, while in Grafton Street, he put his foot on the iron plate at the foot of an electric lamp-post, and immediately received a terrible shock, which threw him on the pavement. For the Corporation, it was admitted that something was wrong with the electric light on the night in question, and evidence was given that no injuries were received by the plaintiff, though he might have received a shock. If we can believe the reporters, somewhat curious evidence seems to have been given by Prof. Barrett for the defendants, who is stated to have said that it was incredible and inconceivable that any injury could be caused by the conditions that existed at the time of the alleged occurrence, assuming that the Board of Trade regulations were at the time carried out. It was incredible that one man catching another who stood on this plate could have been affected by an electric shock. If one can really rely on the report, the latter opinion is a most perilous one, for the danger of seizing hold of a man who is receiving an electric shock is a most subtle and deadly one. Indeed, we have held the danger to be so great, that we laid special stress on this point in our suggestions for dealing with electric shock. In spite of the evidence, however, the Recorder seems to have taken the view that the facts were proved, and though he did not consider that the plaintiff was much injured, he made a decree for £20.

Quite American, you know!—They know how to advertise in America. The following instance taken from a New York exchange is nearly as tall as the bald head story:—"A tall, *distingué* man, dressed in the very latest style of evening dress, and Inverness cape coat, who sauntered up and down Broadway, visited all the hotel offices and cafes. Wherever he could get into a crowd he would first attract attention by searching through his pockets as if he had lost his watch or some money. Finally, everybody looking at him, he threw out his chest, touched a hidden spring, and lighted an electric lamp inside of his shirt bosom, and presto! the name of a musical comedy stood out in letters red on the linen of his shirt. He would then turn the light out and wander down the street, the perfect picture of a well-dressed man about town."

Wanted—A Man.—An American editor perpetrates the following:—

The telephone bell in the office of Blank, Dash & Co. jingled noisily. The young woman who attends to the typewriting responded.

"Is this Blank, Dash & Co.?" came a faraway voice.

"Yes."

"I want Blank, Dash & Co."

"This is Blank, Dash & Co."

"Who is this talking?"

"It's Blank, Dash & Co."

"Is this Blank?"

"No; it's Blank, Dash & Co."

"Say, this is a lady talking, isn't it?"

"I tell you it is" ——

"It's a lady, isn't it?"

The young woman hesitated. She was annoyed by the caller's persistency.

"Yes," she said, "it's a lady, but"——

"Well," said the caller, "will you please have a man step to the 'phone?"

"A man?" repeated the typewriter.

"Yes. I want somebody I can damn."

The young woman set the receiver down very suddenly, and called Mr. Dash to take her place.

Presentation.—An address and a handsome gold watch have been presented to Mr. A. D. Little, of the Eastern Telegraph Company, Bombay, on the eve of his departure for Aden, where, says the *Delhi Morning Post*, he is to take up the duties of assistant superintendent of the Eastern Telegraph Company's office.

Royal Institution.—We have received a copy of the syllabus of Prof. Oliver Lodge's course of six lectures (adapted to a juvenile auditory) on "The Principles of the Electric Telegraph." These lectures will be delivered at 3 o'clock on Tuesday, December 28th, December 30th, January 1st, January 4th, January 6th, and January 8th. On February 4th, Mr. A. A. Campbell-Swinton lectures on "Some New Studies in Cathode and Röntgen Radiations." On March 4th, Prof. T. E. Thorpe will lecture on "Recent Results of Physico-Chemical Inquiry." Three lectures are to be given on "The Halogen Group of Elements," by Prof. Dewar, on Thursdays, January 20th, 27th, February 3rd. Five lectures are to be given on "Recent Researches in Magnetism and Diamagnetism," by Prof. J. A. Fleming, on Thursdays, March 3rd, 10th, 17th, 24th, 31st.

Lecture.—Under the auspices of the Dundee Institute of Engineers, a lecture was delivered at Dundee on 16th inst., on "Electric Traction for Tramways," by Mr. David Urquhart.

King's College.—The Lent term of the engineering, architecture and applied science division opens on January 13th. See our "Official Notices."

Meeting of the Société des Electriciens.—The first meeting of the new season took place on November 10th, M. Violle being in the chair. The earlier part of the meeting was taken up with various financial questions relating to the work of enlarging the Ecole Supérieure d'Electricité. M. Mascart asked the society to authorise the council of administration to negotiate a loan of 60,000 francs. The necessary permission was granted. The loan is to take the form of bonuses of 100 francs, producing an annual interest, and repayable in 20 yearly instalments. M. G. Loppé showed in projection some photographs of lightning falling on the Eiffel Tower during violent storms. M. P. Janet described the principal workshop courses of study of the Ecole d'Electricité, and showed some of the chief apparatus constructed by the pupils. Lastly, Dr. Foveau de Courmelles spoke of electro-therapeutic appliances, and discussed the principal precautions to be taken for utilising the systems of distribution in electro-medical operations.

Popularising Science.—"Bumble Bee" writes to the *Engineer* expressing gratification at the spread of education and the growing taste for science, and sends the following extract from a popular weekly journal showing how the editor endeavours to satisfy the demand:—

"'One often wonders,' writes a lady, 'how the exceptionally small wings a bumble bee possesses can keep his rather large body in the air. And it is not generally known that the said wings are simply the rudders by which he steers his way. On coming out of his hive, or hole, he is very much smaller than when we see him flying in the air. One will notice he rests on the ground a second or so before starting off. During this time he is filling himself with air, and when light enough he rises and sails off, steering his course with his wings.'

"This is indeed a curiosity of nature, and one I never heard of before. Can any reader tell me whether it is indeed a fact that the bumble bee converts himself into a sort of animated balloon?"

P.S.—Is it difficult to be an editor?

NEW COMPANIES REGISTERED.

Bournemouth and Poole Electricity Supply Company, Limited.—Registered December 9th, with capital £150,000 in £10 shares, to carry on the business of electrical, chemical, mechanical, and general engineers, contractors, suppliers of electricity, and manufacturers of electrical apparatus. The subscribers (with one share each) are:—A. H. Sanderson, Darfield, Bournemouth, gentleman; B. H. Van Tromp, 4, Hyde Park Terrace. W., gentleman; J. A. Hosker, Kirkleathan, Bournemouth, surgeon; F. W. Reynolds, Shortlands, Kent, manufacturer; R. P. Sellon, 4, Chandos Street, Cavendish Square, electrician; F. E. Savory, 20, Northgate Street, Bury St. Edmunds, gentleman; H. G. Jones, The Chalet, Esher, stockbroker. The number of directors is not to be less than three, nor more than seven; the shareholders are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, Moorgate Court, E.C.

Hydro-Pneumatic Traction Syndicate (55,190).—Registered December 9th with capital £3,000, in £1 shares, to manufacture, sell and deal in motors, cycles, and hydraulic and pneumatic appliances, compressors, reservoir and power accumulators, &c., and to carry on the business of mechanical and electrical engineers, contractors, boiler makers, iron and metal founders. The subscribers (with one share each) are:—H. Lane, 35, Carpenter Road, Edgbaston, Birmingham, engineer; T. J. Perrett, 181, Queen Victoria Street, E.C., engineer; W. H. Liversidge, Leadenhall Market, salesman; J. Liversidge, 196, Old Street, E.C., coach builder; M. W. Shaw, Blenhein House, Brighton, gentleman; P. P. Liversidge, 196, Old Street, E.C., coach builder; W. H. Bulbeck, 34, Queen Street, E.C., solicitor. The number of directors is not to be less than three nor more than seven; the first are:—T. J. Perrett, W. H. Liversidge, J. Liversidge, P. B. Liversidge, M. W. Shaw, and H. Lane. Qualification, 100 shares; remuneration as fixed by the company. Registered by W. H. Bulbeck, 34, Queen Street, E.C.

The Shannon Electric Power Syndicate, Limited (2,166).—Registered in Dublin December 8th, with capital £12,000 in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity for the purpose of light, heat, motive power, or otherwise. The subscribers (with one share each) are:—Gerald R Deane, Celbridge Abbey, Celbridge, knight, colonel, J.P.; Lurgan, 27, Lowndes Square, London, peer; J. F. Bannatyne, Limerick, D.L.; Vere W. Brown, Balnagowan, Upper Rathmines, J.P.; Richard W. Booth, 32, Leeson Park, Dublin, merchant; W. A. F. Verschoyle, Dundrum, co. Dublin, J.P.; John Chambré, Mispel House, Dublin, merchant. The number of directors is not to be less than two nor more than seven. The first are the Right Hon. W. Brownlow, Baron Lurgan, Col. Sir G. R. Dease, V. W. Brown, and J. F. Bannatyne. Qualification, £100; remuneration to be fixed by the company. Registered by T. W. Hardman & Son, 14, Molesworth Street, Dublin.

R. D. Tompson, Limited (55,035). — Registered November 30th with capital £1,000 in £1 shares, to carry on the business of electric light, telegraph, electrical, mechanical and general engineers and contractors, brass founders and metal workers. The subscribers (with one share each) are:—R. D. Tompson, Hebers House, Hollin's Lane, Middleton, electrical engineer; Mrs. M. Tompson, Hebers House, Hollin's Lane, Middleton; E. C. Tompson, 99, Hebers House, Middleton, warehouseman; Mrs. F. B. Tompson, 99, Hebers House, Middleton; E. Tompson, 57, Edward Street, Middleton, salesman; Miss F. M. Tompson, 57, Edward Street, Middleton; Mrs. M. Tompson, 57, Edward Street, Middleton. Registered without articles of association. Registered office, Hollin's Lane, Middleton, near Manchester.

Electric Hansom Cab and Carriage Syndicate, Limited (55,227).—Registered December 11th with capital £2,000, in £1 shares, to carry on the business of manufacturers and proprietors of electric and other motor cabs, hansoms, carriages and other vehicles, generators of, and dealers in motive power, proprietors of charging stations, cycle manufacturers and agents, &c. The subscribers (with one share each) are:—S. Harmer, 56, Coleman Street, E.C., printer; W. Hall, 8, Dixon Street, E., clerk; R. C. Neighbour, 27, Plassy Road, Catford, manager; H. E. Greville, Towcester, Northamptonshire, clerk; J. S. Jarvis, Towcester, Northamptonshire, solicitor; T. W. Precious, 1, Norland Gardens, Notting Hill, W., clerk; G. Hickson, Towcester, Northamptonshire, clerk. Registered without articles of association. Registered office, 28, Brook Street, Grosvenor Square, W.

Electroid Gas Light Syndicate, Limited (55,278).—Registered December 15th with capital £50,000 in £1 shares, to carry on the business of an electroid light and electroid gas light company in all its branches, and to construct, lay down, establish, and carry out all necessary cables, wires, lines, accumulators, lamps, and works. The subscribers (with one share each) are:—G. Lightollers, 21, Davenport Avenue, Withington, clerk; J. Samuels, 50, Bradshaw Street, Moss Side, Manchester, bookkeeper; C. E. Craig, 20, Haywood Street, Moss Side, Manchester, clerk; W. G. Forsyth, 60, Wellington Street, Moss Side, Manchester, clerk; E. Berry, 50, Portsmouth street, Moss Side, Manchester, accountant; G. Foggo, 19, Nursery Street, Pendleton, Manchester, secretary; R. H. Harvey, 108, Brickley Street, Moss Side, Manchester, clerk. The number of directors is not to be less than three, nor more than ten; the subscribers are to appoint the first. Qualification, £200; remuneration as the company may decide. Registered by Ker & Rowe, 8, Bucklersbury, E.C.

Carbon (New) Syndicate, Limited (55,282).—Registered December 15th with capital £30,000, in £1 shares, to adopt an agreement with the Carbon Syndicate, Limited, and its liquidator, and to carry on the business of carbon manufacturers, electricians, suppliers of electricity, engineers, and electrical apparatus manufacturers. The subscribers (with one share each) are:—E. A. Green, 61, Southwark Bridge Road, S.E., clerk; T. E. Greenwood, Grasmere, Allfarthing Lane, Wandsworth, electrician; H. P. Holdway, 38, Vassal Road, North Brixton, accountant; H. Dobbin, 4, Balmuir Terrace, Putney, gentleman; E. L. Jackson, The Hollies, West Norwood, clerk; E. W. White, The Clives, King's Hall Road, Beckenham, clerk; W. A. Andrew, 38, Hornsey Park, Hornsey, N., book-keeper. The number of directors is not to be less than three, nor more than seven. The subscribers are to appoint the first; qualification, £250; remuneration, £500 per annum, divisible. Registered office, 39, Victoria Street, S.W.

Chitty Dynamo and Motor Company, Limited (55,284).—Registered December 16th, with capital £200,000 in £5 shares (24,000 preference), to acquire certain patents relative to improvements in electric dynamos, and connected with rope or cable

traction, to adopt several agreements, and to carry on the business of electrical and general engineers and contractors, boiler makers, iron and brass founders, launch and ship builders, &c. The subscribers (with one share each) are:—A. Dawson, 3, Ludgate Circus Buildings, E.C., printer; H. Lane, 35, Carpenter Road, Edgbaston, engineer; J. Sturgeon, 28, Cumberland Park, Willesden, engineer; H. Chitty, 6, Hamilton Terrace, Twickenham, engineer; J. H. White, 3, Lancaster Road, W., clerk; H. W. Evans, St. George's House, Eastcheap, accountant; D. J. Edmonds, 30, Budge Row, E.C., solicitor. The number of directors is not to be less than three nor more than seven. The first are H. Lane, A. Dawson, W. J. P. Moore, and H. Chitty. Qualification, £250; remuneration, £5 each per board meeting attended and a share in the profits. Registered office, St. George's House, Eastcheap, E.C.

Oldham, Ashton and Hyde Electric Tramway, Limited (55,318).—Registered December 18th with capital £80,000, in £10 shares (4,000 preference), to acquire the powers, rights and privileges conferred by the Oldham, Ashton-under-Lyne, Hyde and District Electric Tramways Order, 1896, and to construct, lay down, equip, maintain and work (by horse, electricity, or other mechanical power) the tramways comprised by the said order. The subscribers (with one share each) are:—L. Atherley Jones, D.C., M.P., 4, Paper Buildings, Temple, E.C.; A. R. Monks, 83, Cannon Street, E.C., director; J. Devonshire, 83, Cannon Street, E.C., electrical engineer; E. Garcke, Donington House, Norfolk Street, W.C., electrical contractor; S. P. W. d'A Sellon, Donington House, Norfolk Street, W.C., civil engineer; C. Walmsley, Donington House, Norfolk Street, W.C., secretary; A. S. Hodgson, 41, Basslin Park Road, Shepherd's Bush, W., clerk. The number of directors is not to be less than three, nor more than seven; the first are E. Garcke, A. R. Monks, L. Atherley Jones, R. Whittaker, J.P., and T. Higginbottom, J.P. Qualification, £100; remuneration, £250 per annum, and 5 per cent. of the amount paid as dividend on the ordinary shares, divisible. Registered by A. C. Godfray, 60, Finsbury Pavement, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Telephone Construction and Manufacturing Company, Limited (15,212).—This company's annual return, made up to June 24th, was filed on December 6th. The capital is £234,938 in 47,363 preference shares of £1, 224,850 ordinary shares of 10s., and 75,150 ordinary shares of £1 each. 224,850 10s. ordinary shares have been taken up, and £112,425 paid.

Midland Electric Corporation for Power Distribution, Limited (53,071).—This company's statutory return was filed on November 8th, when seven shares were taken up out of a capital of £200,000 in £5 shares, and no calls made.

Melton Mowbray Electric Light Company, Limited (53,018).—This company's statutory return was filed on November 11th, when seven shares were taken up out of a capital of £10,000 in £5 shares. No calls have been made.

Mevagissey Electric Lighting Company, Limited (46,688).—This company's first annual return was filed on December 10th; 1,132 shares have been taken up out of a capital of £1,500 in £1 shares, and £1,132 paid.

Brush Electrical Engineering Company, Limited (29,533).—This company's annual return was filed on November 3rd. The capital is £660,000 in £2 shares (150,000 preference). 90,000 of each class have been taken up, and £360,000 paid.

Miners' Lamp Electric Lighting Company, Limited (28,019).—This company's annual return was filed on September 23rd. 301 shares have been taken up out of a capital of £3,000 in £5 shares. 190 are considered as paid, and £5 has been called on the rest. £550 has been paid and £5 is in arrears.

Electrical Guarantee and Trust, Limited (54,954).—The registered office of this company is now situate at 39, Victoria Street, Westminster.

Aurora Electric Lighting and Distribution Company, Limited (34,109).—This company's annual return was filed on October 27th, when 5,935 shares were taken up out of a capital of £25,000 in £1 shares, 5,000 are considered as paid, and £935 has been received.

Canton (Waipori) Mining and Electric Power Company, Limited (51,909).—This company's statutory return was filed on September 4th, when seven shares were taken up out of of a capital of £150,000, in £1 shares, and £7 paid.

British Insulated Wire Company, Limited (52,285.)—This company's statutory return was filed on September 17th. The capital is £400,000, in £5 shares (40,000 preference and 39,400 ordinary shares have been taken up, and 5,530 preference and 29,375 ordinary are considered as paid; £1 10s. per share has been called on the rest, and £36,742 10s. has been received.

Corbridge Electric Lighting Company, Limited (52,491).—This company's return, made up to September 16th, was filed on the following day. Seven shares have been taken up out of a capital of £4,000 in £5 shares, but nothing has been paid.

CITY NOTES.

The House-to-House Electric Light Supply Company.

An extraordinary general meeting of the shareholders of the above company was held on Friday afternoon at Winchester House.

Mr. R. Benton (chairman) said he would read the resolutions, viz: (1) That this meeting approves of the terms of the agreement dated November 29th, 1897, and purporting to be made between the company of the one part, and the several persons, corporations, and firms executing the same in the schedule thereunder written (thereinafter called "the holders of the founders' shares"), of the other part, which agreement has, for the purpose of identification, been marked with the initials of the chairman, and of the scheme therein contained for the surrender by the holders of the founders' shares in the company of the founders' shares held by them respectively. (2) That the directors be, and they are hereby authorised to take such steps as they may deem expedient to carry into effect the said scheme referred to in the previous resolution, and to offer forthwith to the holders of the founders' shares the ordinary and preference shares to which they will respectively become entitled under the agreement referred to in the previous resolution upon the terms therein set forth, and to allot the said shares conditionally or otherwise: the holders of the founders' shares agreeing on their part to the cancellation of the founders' shares, and to all necessary legal steps to complete the transaction. (3) That the directors be and they are hereby authorised to permit the holders of founders' shares to postpone the payment of the sums payable under the said agreement on January 1st, 1898, in respect of the ordinary and preference shares to be allotted to the holders of founders' shares thereunder till such date subsequent to the cancellation of the said founders' shares or otherwise as the directors may deem expedient, but such postponement is to be without prejudice to the right of the holders of the ordinary and preference shares to be allotted as aforesaid to receive dividends thereon as if such sums had been duly paid on January 1st, 1898, as in the said agreement provided." In recommending those resolutions to the adoption of the meeting the directors believed that they were acting in the general interests of the undertaking as well as in permanent interests of the shareholders. They believed they were acting in the general interests of the undertaking because it had been found by experience and observation that the principle of founders' shares, however useful it might be at the inception of an undertaking such as theirs, had proved in practice to be inconvenient and injurious at a latter stage of its development. The fact was, of course, that the rights of founders' shares for dividend only arose after the rights of the ordinary shareholder had been in a large part satisfied, and they were, therefore, always most pressing when those of the ordinary shareholders were becoming less urgent, a condition of things which resulted often in a divergence of policy coming into operation. That had been already recognised by other companies and, in adopting the course which they recommended to the shareholders, they were only really following the example of others. They believed that the arrangement was in the permanent interests of the shareholders because they believed they had made a good bargain for them. The terms of the agreement represented, so far as the founders' were concerned, a binding contract and they could, therefore, speak without prejudice in regard to what they believed to be its merits from the point of view of the shareholders, and it was obvious that while the company got by the arrangement the use of £50,000 of capital, what the shareholders gave for it was the difference between the market rate upon that sum and the full dividend rights, and what the shareholders got was the full dividend rights upon the whole of their capital after 7 per cent. in lieu of half dividend rights after that dividend. After long and serious consideration, and as the result of protracted negotiations, they had satisfied themselves that the future of the company, both in regard to rate of profit and growth of capital, was such as to make the arrangement highly profitable during the remaining part of the company's statutory term. He was reluctant, for personal, as well as public reasons, to indulge in any definite forecast, but he might say generally that if the company should ever pay 10 per cent. upon £250,000 of capital, or a larger dividend upon a proportionately smaller capital, the shareholders would be gainers by the arrangement.

Mr. Leese seconded the resolutions, and they were carried unanimously.

Allgemeine Elektricitäts Gesellschaft.

From the annual report and balance-sheet for the year ending June 30th, 1897, we learn that the business of this large and enterprising company continues to prosper. Their gross profit for the year was 7,179,811 marks, from which, after deducting the cost of removing part of their workshops to a new site, and other expenses, a net profit of 5,821,536 marks remained over. Out of this a dividend of 15 per cent. was paid on the capital of 25,000,000 marks; 1,000,000 marks was paid into the suspense account, and considerable sums in commissions and bonuses to the staff. Some idea of the progress of the company may be obtained from the following list of the annual number of dynamo machines built in the last four years: in 1893-94, 1,555; in 1894-95, 2,049; in 1895-96, 4,000; in 1896-97, 5,189. The new workshops will be capable of turning out 10,000 machines per annum. Among the numerous undertakings promoted by this company, may be mentioned one which has recently been started and is called the Electricity Supply Company. This company will undertake the working of installations which are too small or too young

to work profitably on their own account, but yet can be worked profitably by a large company through the reduction of working expenses due to centralisation. The A.E.G. has long devoted its energies to electric traction, and from this report we learn that 49 street railways at work, or in course of construction, owe to it their existence. The great electric power transmission works which the A.E.G. is erecting at Rheinfelden have met with considerable difficulties from floods, but the dynamos are now being erected, and it is hoped that the great installation will make a start in the beginning of next year. The electro-chemical works at Bitterfeld have just been fitted up with machinery developing 2,500 H.P., and will soon be working to their full capacity. Large electro-chemical works on the Bitterfeld system are also being erected at Rheinfelden. The total number of persons employed by the A.E.G. is 9,817, of which 6,000 are employed in the machine and armature factories. The Electrical Company, Limited, 122 and 124, Charing Cross Road, are the sole representatives of the A.E.G. for this country and the British Colonies.

British Columbia Electric Railway Company.

In a circular to the shareholders, the secretary reports:—"My directors desire me to convey to you the working results of this company for the first half-year of its existence. The directors particularly wish to draw your attention to the fact that the period under review is two weeks less than the full six months, the properties having been taken over on April 15th, and the books made up to September 30th. For that period the results were as follows:—

	Gross earnings.	Working expenses.	Net profits in British Columbia.
April (15 days)	$10,992.55	$7,900.58	$3,091.97
May	21,604 54	15,741.31	5,863.23
June... ...	23,305 24	16,443.28	6,861.96
July... ...	23,435.74	16,361.44	7,074.30
August ...	26,739.61	17,730.20	9,009.41
September ...	24,665.91	17,336.17	7,329.74
	$130,743.59	$91,512.98	$39,230.61 = at 4·86, £8,072

Deduct expenditure in London for six months, directors' fees, office rent, expenses, say	£700
Interest on £250,000 4½ per cent. debentures, half-year	5,625
Trustee fee on above	417
Leaving a surplus of earnings for 5½ months over expenses and fixed charges for six months of ...	1,330
The net profit for the month of October is cabled at $9,467. If half this be added, $4,733 say ...	970
The surplus for the complete six months would be	£2,300

This satisfactory result is due to steady improvement in business, fairly evenly distributed amongst all the branches, and little benefit, if any, has as yet been derived from the various improvements which are at present being carried out with the capital derived from the issue of the income bonds. Of the improvements, to carry out which the issue of income bonds was made, the extension to Stanley Park, and the improvements on the Westminster branch have been satisfactorily completed, and the economy of £3,500 per annum expected from them should shortly commence to show in the returns. The installation of water-power at Victoria is in course of construction, and, the board anticipate, will be finished about March 31st. Before finally making this important expenditure of capital, the board decided to call in still further expert advice, and secured the services of Mr. J. M. Campbell, of Toronto, electrical engineer of very high standing, and of long experience in this class of business. The board is glad to state that Mr. Campbell not only confirmed the opinion of the previous expert, but put the increased annual profits to be derived by substitution of water-power for steam-power, and the other improvements in Victoria now in hand, at £9,000 per annum. The installation of water-power at Vancouver has been deferred for the present. I beg to attach statement of the working results for the month of October, as received by cable, compared with the working results for the same period for 1896, and the board is happy to state that it is now in a position to issue to shareholders similar comparative statements for each month on 26th day of the following month."

Statement of Earnings and Expenses as Received by Cable for the Month of October, 1897.

Gross earning.	1896-97.	1897-98.	Inc. or dec.
Railway—			
Vancouver branch	$3,626	$4,166	+ $540
Victoria branch... ...	5,506	5,905	+ 400
Westminster branch	5,523	7,332	+ 1,809
Lighting—			
Vancouver branch, Westminster branch	5,314	6,281	+ 967
Victoria branch...	3,393	4,069	+ 673
Total gross earnings	$23,364	$27,753	+ $4,389
Working expenses...	19,465	18,286	− 1,179
Net profits...	$3,899	$9,467	+ $5,568
Aggregate gross earnings from April 15th to the end of October	...	$158,496	...
Aggregate net profit from April 15th to the end of October		48,697	...

Babcock & Wilcox, Limited.

An extraordinary general meeting of the shareholders of Babcock and Wilcox, Limited, was held on Tuesday week, at the Cannon Street Hotel, E.C., Mr. Andrew Stewart presiding. The following resolutions were passed:—(1) "That the capital of the company be increased to £320,000, by the creation of 8,000 new ordinary shares of £10 each, to rank *pari passu* with the existing ordinary shares, and to rank for dividend as from January 1st, 1898." (2) "That, subject to payment of the amount of such shares on January 1st, 1898, or within such extended period (if any) as the directors may in any case think fit to allow, the directors be authorised to offer the said 8,000 new ordinary shares at par to the holders of preference and ordinary shares whose names appear upon the register of members on the said December 14th, 1897, in the proportion of one of such new shares to every three preference or ordinary shares—fractions less than three not to be taken into account—but for the purpose of such allotment preference and ordinary shares may be considered as combined; and that the directors be authorised to dispose of any part of the shares not issued to the members, to such persons, in such manner, and at such premium as they, the directors, think fit."

The Brockie-Pell Arc Lamp Company, Limited.

Lord Suffield presided at a meeting of this company held at Cannon Street Hotel yesterday, and said that the meeting was an informal one, and there was no business before them. When the accounts were made up, they would be able to call the shareholders together and put a statement before them. They had had very considerable difficulties to contend with, amongst others, the engineering strike, which had very much delayed their manufacturing, though they had procured what they wanted from abroad. They had considerable orders on hand, which they had been unable to carry out. The business had been at least doubled since it became a separate one. He saw no difficulties before them, but they must have a little time. Mr. Brockie had invented a new lamp, which was thought would be cheaper and a longer burning lamp, and, perhaps, the best ever offered to the public.

A Shareholder referred to the violent fluctuations in the price of the shares, but the chairman said that it was not due to the action of any member of the board, for they had neither bought nor sold shares.

After a statement from the auditor as to when the accounts would be ready, the chairman moved the adjournment of the meeting till the beginning of March, 1898.

Electrical Copper Company.

In their annual report, the directors state that a portion of the company's works at Widnes has been put into successful operation, and that copper sheets are now being produced there of a highly satisfactory quality, in execution of orders received by the company. Owing, however, to unavoidable delays in the delivery of the machinery, a state of matters in which the company is not singular, and notwithstanding the closest attention by the board, the works were not ready for turning out manufactured copper until the end of October, and the directors are consequently not in a position to give any report regarding commercial results. The experimental laboratory in Paris, taken over by the company, was found to be too small for extensive tests of the process, and was transferred to Brunoy (near Paris), where a factory now exists suitable for experimental tests and the production of certain classes of copper sheets for sale. Attention has been given to testing the working details of the patents of the company, and several important additions have been elaborated and covered by supplementary patents.

North-East Electric Railway Company.—The North American Trust Company of New York and London is prepared to pay, on and after January 1st, the coupons due on that date of the bonds of the above railway at its London office, 95, Gresham Street, E.C.

Bournemouth and Poole Electricity Supply Company.—Letters of allotment and regret for the preference and ordinary shares offered for subscription have been posted.

Smithfield Markets Electric Light Company, Limited.—The first batch of letters of allotment and regret has been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 19th, 1897, were £1,080; week ending December 20th, 1896, £1,082; decrease, £2; total receipts for half-year, 1897, £24,060; corresponding period, 1896, £24,103; decrease, £43.

The Liverpool Overhead Railway Company. The receipts for the week ending December 19th, 1897, amounted to £1,342; corresponding week last year, £1,116; increase, £226.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 17th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,949.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Dec. 15th.	Closing Quotation, Dec. 22nd.	Business done during week ended December 23nd, 1897. Highest.	Lowest.
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	101 —105	101—105	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5½— 6½	5½— 6½	...	...
923,960£	Anglo-American Teleg., Ltd. ...	Stock	£2 2s.	£2 9s.	£2 13s.	58 — 60	59 — 61	60	59½
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	105 — 106	106 — 107	107	106½
3,038,020£	Do. do. Defd.	Stock	...	...	...	12¼— 12⅝	12⅝— 13¼	13 1/16	12⅝
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	16 — 16½xd	16 — 16½	16½	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	5 %	...	114 —118	114 —118	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	183 —188	183 —188	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106½	105⅞
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	3/16— 4/16	3/16— 4/16	4/16	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	8½ — 9½	8½ — 9½	9¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ — 19½	18½ — 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	4½%	103 —106%	103 —106 %	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	10 — 10½	10¼— 10⅝	10⅝	10 7/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	17 — 17½	17 — 17½	17⅜	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	18 — 19	18 — 19	18⅜	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 —104	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	130 —133	130 —133	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7½	18¼— 18⅜	18¼— 18⅜	18⅜	18⅜
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	100 —104	101 —105	...	...
100,500£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	101 —104	102 —105	104½	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	132 —135	132 —135	133½	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	100 —104	101 —105	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	101 —104	102 —105	104	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 —106	103 —106	103½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	108 —111%	108 —111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½— 12	11½— 12	11 13/16	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17½ — 18	17⅞ — 18	17⅞	17 9/16
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	10%	25½ — 26½	25½ — 26½	26¼	26⅛
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	102 —105	102 —105	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	52 — 55	52 — 55	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6⅜ — 6⅝	6⅜ — 6⅝	6 11/16	6½
15,000	Do. 5 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	...	...
130,766	Do. do. Nos. 119,235 to 250,000, £4 paid	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —109	104 —109	107	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	9/16 — 11/16	9/16 — 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7½ — 8½	7½ — 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	139½	139
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3⅜— 4¼	3⅜— 4¼	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	102 —107	102 —107	...	...
15,609	West African Teleg., Ltd., 7,501 to 23 109	10	nil	4 %	nil	4½ — 5½	4½— 5½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	...	...
64,256	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	2 %	9⅜— 10¼	9⅜— 10¼	10 1/16	9½
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7¼— 7⅜	7¼— 7⅜xd	7 9/16	...
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2⅜— 3¼	2⅜ — 3¼	3 1/16	2⅞
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	1⅛%	1⅛%	1 %	1/16— 2/16	1/16— 2/16	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	7⅜— 8¼	7⅜— 8¼	7 13/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	107 —110	107 — 110	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7%	105 —110	105 —110	...	...
160,100£	Do. do. 5 % Ster. Bonds.	100	5 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12½ — 13½	12½ — 13½	13¼	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6½	6¼
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	10½— 11	10½— 11	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	4½%	4½%	113 —116	113 —116	...	...
40,000	City of London Elec. Lightg. Co., Ltd, Ord. 40,001—80,000	10	5 %	5 %	7 %	26½ — 27½	26 — 27	26⅜	26
10,000	Do. do. Prov. Certs.	5	...	...	...	26 — 27	25½ — 26½	26⅜	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17⅜	17½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —136	131 —136	134	132½
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	...	nil	nil	13½ — 13⅝xd	13½— 14	14	13½
20,000	Do. do. do. 6% Pref., 40,001—60,000	10	...	6 %	6 %	15½— 16	15½— 16	15 13/16	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	9 — 10	9 — 10	9⅜	9⅜
10,000	Do. do. 7 % Cum. Pref.	5	...	...	...	11 — 11½	11 — 11½	11 7/16	11⅜
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	3 %	4 %	5 %	18½ — 19½	18½— 19½	19½	18¾
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	18½ — 19½	18½— 19½	18½	...
220,000	Do. 4½% first mortgage debenture stock	...	...	4½%	4½%	119 —123	119 —123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	17½ — 18½	17½— 18½	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd. Ord., 101-20,080	5	6½%	7½%	10½%	17 — 18	17 — 18	17⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	103 —106	103 —106	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2½— 2¾	2⅝— 2⅞	2 13/16	2⅝
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	5 %	7 %	9 %	16 — 17	16 — 17	16 9/16	16½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share arrants, profits being used as capital.

‖ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next. ‖

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME,	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Dec. 15th.	Closing Quotation Dec. 22nd.	Business done during week ended Dec. 22nd, 1897. Highest.	Lowest
30,000	British Electric Traction	10	...	...	...	15⅜ — 16¼	16⅜ — 17¼	18 3/16	16
90,000	Brush Elecl. Engng. Co., Ord., 1 to 90,000...	2	2½%	...	...	1⅜ — 2	1¾ — 2	2 3/16	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	2⅛ — 2⅜	2⅛ — 2⅜	2¼	2⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —105	103 —106	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9½ — 10	9⅜ — 10¼	10	9⅞
143,106	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5½ — 6	5 13/16	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1 — 1⅛	1 — 1⅛	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	4¼	...
630,000£	City and South London Railway	Stock	1⅛%	1 1/16%	1 1/16%	66 — 68	66 — 68	67½	66
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	2 — 2½	2 — 2½	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5 %	5½%	2⅜ - 3¼	2½ — 3	2 11/16	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	5½%	4½ — 5½	4½ - 5½	4⅜	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	6 %	2¼ — 2⅜	2⅜ — 2⅝	2½	2 7/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3½ — 3⅝	3½ — 3⅝	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	⅛ — ¼	⅛ — ¼	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	20 — 21	20 — 21	20⅜	20⅛
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	110 —115	110 — 115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	23 — 24	23 — 24	23⅞	23½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	103 —107	103 —107	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅜%	2⅞%	11½ — 11⅝	11 7/16 — 11 9/16	...	-
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16 — 16½	16 — 16½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	36 — 39	38½	38¼
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000	10	...	...	...	12½ — 13	12½ — 13	12⅞	12¾

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1893—0%; 1894—7%; 1895—7%; 1896—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.

Electric Construction Corporation, 6 % Debentures, 104—106.

House-to-House Company, 4½% Debentures of £100, 107—111.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 14½—15½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8¾. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 2⅝—2⅞.

* T. Parker, Ltd., £10 (fully paid), 12¼.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

REVIEWS.

Modern Gas and Oil Engines. By Frederick Gover. Manchester: The Technical Publishing Company. 1897.

There are not so many treatises on internal explosion engines but that this one, of small size though it be, should not find a place. Interesting as are the modern heat engines to the thermo-dynamic student they do not afford the same interest to the more essentially mechanical man as his old friend the steam engine. In a sense the steam engine demands more study and care to make it an economical machine than does the internal combustion engine.

The steam engine works with a fluid whose heat we now know we should endeavour to conserve—a critical fluid which within the working temperature ranges of a steam engine will become water or steam, and in ringing the changes between the two fluids steam may be a very wasteful agent. With fire engines the essential point is that they should be made to work on correct principles, and, this done, the working fluid will take care of itself to such an extent that it is so hot that we must provide against its temperature effects by means of water jackets. The gas engine is but new as a practical and commercial fact, yet motive power was attempted from gunpowder as early as 1678, and the steam engine coming forward practically put a stop to internal combustion engines. Nevertheless, patents for gas engines were taken out from time to time, and one Lebon even explained the merits of compression before explosion. The water jacket was added prior to 1838, but it was not till 1860 that a really practical engine was brought out by Lenoir, and at this time also the importance of rapid expansion after explosion was recognised as necessary to economy; of course, given a sufficiently rapid expansion, the water jacket might hardly be needed. In this idea the free piston engine had its birth, and this dates from 1863, one year prior to which Beau de Rochas had formulated that cycle of operation now known as the Otto cycle. De Rochas showed a very clear and advanced knowledge of the subject. In fact, he seems to have seen through and round the whole question, and he was undoubtedly to the gas engine what Watt was to steam in everything but opportunity. Watt found the world without a motive power; de Rochas found a world with a full appreciation of the steam engine. Otto simply followed the lead of de Rochas, so that one marvels how the Otto patent could have been taken out in the face of de Rochas' patent of 1862, which had been public property for 14 years when the Otto patent was taken. As de Rochas was the inventor of the modern engine, so is the modern Otto engine hardly different from the early Otto engine of 1876. The slide valve has given way to the ignition tube.

Our author wisely gives but a brief *resumé* of the history of gas engines. He then passes on in Chapter II. to the arrangement of the engine room, in which he makes some good notes. Chapter III. deals with types of gas engines. The expiration of the Otto cycle patent of course at once reduced most other engines in value, and all makers adopted the Otto cycle. No engine had been able to compete with the Otto in economy, except those of Atkinson, which showed an economy of gas of nearly 20 per cent. as compared with the Otto engines, but were mechanically expensive to maintain.

Generally speaking, gas engines are all alike in principle, like steam engines, merely varying their details and possessing various starting devices when of large size. A few of the chief French and German engines are briefly described. Next follows the testing of engines, rope brake descriptions, and illustrated descriptions of indicators, one of which, the Wayne, which takes a diagram in sections, is

worth more attention than has yet been accorded to it. It is specially suitable for high speeds.

The practical analysis of coal gas is awarded a chapter, the directions in which will enable a student to acquire a knowledge and practice of analysis.

In dealing with design, we are glad to see that the balancing is recommended to be done by weights on the crank, not in the wheels. In this, and numerous other items, the author shows his practical knowledge. He gives a rule for crank shaft diameter which gives exceptionally large diameter. He uses as a factor the maximum pressure corrected for inertia. The rule may give correct enough results, but the author might have emphasised his statement by pointing out how the crank of a gas engine is exposed to reversed bending and twisting moments, alternately being driven by and driving the piston. His figures for crank pin and shaft bearing pressures seem correct. We note in the chapter on the effects of combustion the sentence, "*If* the specific heat be sensibly constant, then the pressures produced will be proportional to the heat developed at a given time." Well, quite so! But is it worth while basing much argument as to diagram pressures and perfection of combustion upon such an *if*? Low pressures are attributed variously to dissociation, to water vaporisation, or to imperfect combustion. No one seems to accept the possible increase of specific heat at high temperatures as an explanation—we are inclined to think *the* explanation of these facts. That gases do undergo an increase of specific heat seems to be certain as temperature rises.

Oil engines being only modified gas engines, occupy much less of the book, and then, too, only so far as details are concerned. In principle there is no difference between a gas and a petroleum engine, and the carrying out of the idea in practice involves comparatively small changes, so that some makers build convertible engines, the addition necessary being the vaporiser to gasify and vaporise the oil.

Altogether we can cordially recommend this book.

Theory of Electricity and Magnetism. By Charles Emerson Curry, Ph.D. London: Macmillan & Co. 1897.

In this book, originally suggested in outline by Prof. Boltzmann's lectures at the University of Munich, Dr. Curry deals with the theory of electricity and magnetism from the standpoint adopted more particularly on the Continent. The work is intended as a text-book for advanced students, and is concerned with the purely theoretical side of the subject, a knowledge of the experimental researches which form the origin and the test of all theories being assumed.

The standpoint which Dr. Curry adopts may be termed the purely philosophical one. Starting with certain fundamental expressions and assumptions—the mathematical shell in which the kernel of the theory lies—he proceeds to derive from them, and to explain, all the phenomena of electricity and magnetism. The method is one which offers many advantages in a clear exposition of the subject, and is fully justifiable when used in proper historical sequence, as in this case, though contrary to the true scientific spirit when adopted prior to a thorough experimental and many tentatively theoretical investigations of any given class of phenomena.

Prior, however, to adopting in Chapter II. the fundamental differential equations of Maxwell as his starting point, the author shows briefly how they may be derived from the conception of a motion existing in each volume-element of the ether, represented by a vector which stands for Faraday's "electro-tonic" state, hence called the "tonic vector." The author points out that the use of such a displacement vector is preferable to starting with Hertz from a vector representing the force acting on unit quantity at the point, as being further removed from the impossible idea of action at a distance.

In dealing with the question of units, and more particularly with the electrostatic system, the fact that the dimensions of the variables in Maxwell's equations depend upon the particular mechanical analogies from which we derive them is pointed out, and the relations between the dimensions of the variables given in any material system of units and in the electrostatic system is explained. Chapter II. concludes with a discussion of the conditions existing in transition films supposed for the sake of avoiding discontinuity to exist on the dividing surfaces of adjoining media.

The two-fluid theory of electricity is now adopted, with the proviso that whereas the ether is to be regarded as something really existing or material, the "fluids" are conceived merely as a helpful *illustration* of the meaning of the integrals of the fundamental equations. This distinction, as the author points out, is not always made sufficiently clear in Maxwell's treatise.

A demonstration of the equations for wave motion in the ether leads up to a full account of the Hertzian theory of electric oscillations, and this is followed by an investigation of *aphotic* motion of the ether, this term covering the large class of cases in which the disturbance is too slow in comparison with the velocity of propagation to generate true waves. All ether disturbances, with the exception of light, heat, and Hertzian waves, are included in this class, which has its analogue in such *asonic* or slow disturbances of the air as do not produce true condensation or sound waves.

Among the subjects dealt with at length in the later chapters, we may mention the theory of electric images, the motion of the ether prior to the condition of "stationary state" (electrostatic phenomena) and "stationary flow" (current phenomena), the magnetic phenomena accompanying the latter condition, cyclic motions and their mechanical illustration, and electro and magneto-striction, or the deformation of matter under electric and magnetic stress. A comparative study of the equations of Maxwell and Helmholtz leads to an account of those particular integrals peculiar to the latter which represent longitudinal oscillations. These hypothetical ether sound waves are of great interest in connection with the theory of gravitation, which is possibly due to their action.

A brief reference to the cathode and Röntgen rays places them both provisionally as transverse waves at the ultra-violet end of the spectrum; but Dr. Curry wisely suspends judgment until their peculiarities have been still more fully investigated.

We unreservedly express our approval of Dr. Curry's treatise as a careful and clear exposition of a confessedly difficult subject, and we may add that in quality of paper, clearness of type, and freedom from printer's errors, the book is all that a mathematical work should be.

THE CLASSIFICATION OF PATENTS IN RELATION TO A PRELIMINARY SEARCH FOR NOVELTY, AND PATENT LAW REFORM.*

By J. SINCLAIR FAIRFAX, A.I.N.A., A.I.E.E.

Before proceeding with the subject of the address, my first duty is to acknowledge the honour you have conferred in electing me for a second term to the office of president, and to thank you for your kind consideration during the past year.

Complaints are frequently made by disappointed patentees that the British Patent Office grant patents without a preliminary search for novelty, and as this is done in the United States, Canada, Germany and other countries, some advocate our adoption of the United States system. Without stopping now to consider the difference in the fundamental principle of the law of patents in this country and on the other side of the Atlantic, or that the change would require us to give up our convenient system of provisional protection, and would restrict the scope of claims, it appears that the complainants believe the alteration would ensure the validity of all the patents granted. This, as you know, is an erroneous belief, and it must be pointed out that while an official search would certainly be advantageous in some respects, and would be presumptive evidence of novelty, yet even if favourable to the applicant, it is only in the Courts that a particular patent can be pronounced valid after evidence has been taken against it.

In the working of the two systems the British applicant, believing he knows more about his own invention than any official can possibly do, demands a patent as a right, and after complying with the prescribed forms obtains it, with the admonitory conditions clearly set out in the document. The fundamental principle of British patent law is that of encouraging the introduction of a new manufacture into the country, and so long as there is no fraud, the patent is given to the first applicant without question. But under the United States

* Presidential Address, the Society of Patent Agents, November 17th, 1897.

system the principle adopted is that of issuing the patent to the original inventor only, who is not necessarily the first applicant, and therefore the Patent Office there institutes a search amongst all existing patents wherever issued, as well as into books of reference and other material, to see if some prior inventor has described the invention. To do this thoroughly all such material must be carefully classified and indexed, and the applicant must distinctly formulate all his claims, and submit drawings if required by the nature of his invention, so that they can be compared with former claims of similar inventions. The result is that in almost all cases the claims must be restricted within narrow limits; and if the system were adopted here we should have to give up our favourite procedure of first lodging a provisional specification, without claims and without drawings. Necessarily, the United States examiners have the power of rejection; and even when this is fully justified by clear anticipation I am not convinced that the same power officially used here would be beneficial to British inventors.

The United States system is the ideal one, and all experienced agents will freely acknowledge the care and discrimination exercised by the most acute and experienced searchers in the world, before a patent issues from the office of Washington. Owing to careful analysis, and the arrangement of all inventions in about 200 classes, together with elaborate indexes, and the skill and speed with which the most complex cases are investigated and reported on, the issue of a United States patent is in itself frequently cited as a sufficient evidence of the novelty of the invention it describes. But to justify the system it must be accurate, complete, and kept up to date; for if practical difficulties prevent the carrying out of the ideal system it is better to content ourselves with our own system with its advantages and known disadvantages, rather than to rely on a less practical one, however ideally perfect it may be. Evidence relating to the perfection or otherwise of the American system is, therefore, of importance.

In the last issued report of the Commissioner of Patents to Congress for the year 1895, he states that the library at Washington contains 1,544,419 patents, which have been issued by the United States and other nations, and of which 1,213,388 had been issued since 1870. He then goes on to observe:—"In the rapid growth of the industrial arts, and in the enormous accumulation of granted patents, and in the absence of any specific assignment of this close and discriminating work of classification to a particular and well-organised division, there have crept in errors and there remain deficiencies, almost entirely preventible, and yet inevitable from the vast avalanche of records. The exigencies of the office demand a thorough revision of the whole classification." The Commissioner estimates that five years will be required to carry out this revision, at a cost of nearly £65,000, and that 4,000 volumes for reference should also be supplied at a further cost of £2,000.

It will be seen that a serious practical difficulty has arisen in carrying out the requirements of the United States patent law; for it is evident that if the classification, indexes, and other references are defective, so must be the search for novelty, and that under those circumstances many patents have been issued which, in all probability, have been anticipated. Moreover, until the revision is completed and brought up to date, the evil must continue and grow; and considering that nearly five-sixths of the 1,544,000 patents have been issued in the 25 years since 1870, with the ratio of increase growing yearly, it is questionable whether five years will now be sufficient to deal with the arrears, after the work has been authorised by Congress. It should be borne in mind that all civilised nations (with two or three exceptions) are supplying subject matter in the shape of patents to the United States, while that country for her own purposes alone supplies the examiners who have to digest it. Unless the system is modified in some restrictive manner, it appears probable that it must ultimately break down from its own weight; but meanwhile the sense of security hitherto felt in the possession of a United States patent must be considerably shaken.

In proposing "a thorough revision of the whole classification," no recognition appears in the Commissioner's report of the self-destructive element of growth, an element which will ultimately destroy any system of classification. It is assumed that a perfect system of classification can be adopted which will eliminate all former errors; and the same impression prevails in this country. It is believed that inventions can be classified and indexed like the books in a library; certain divisions and classes being formed and added to from time to time upon the original lines, without disturbing the original arrangement. But this is not the case, for not only do additions enlarge each class in which they are placed, but they also tend to change the character of the class itself; and of various diverse classes new ones should be continually formed, and the old ones re-cast. The action of a weighing machine, the opening of a drawer, and the operation of a gas meter, have nothing in common in their ordinary aspect, and they are very properly put in different classes; but owing to the growth of invention they are all linked together by the "penny in the slot" principle, and a new class (27) is provided for them in our own classification. Strictly speaking, they should be put in a subdivision of Class 44, which includes locks and fastenings, because the coin simply acts as a key to unlock a particular part of the machine.

The British Patent Office, not being required to make a search preliminary to granting a patent, is endeavouring to assist an inventor in doing it for himself; and this action should be encouraged and extended. By a series of abstracts of specifications, relating to various periods from 1617 to the present time, arranged in 146 classes, an inventor may see what patents have been taken out on the subject he is most interested in. The only criticism I offer on the work is, that there should be a greater number of classes, a greater sub-division of the subjects, and that the titles have been chosen on different principles; but I fully acknowledge the difficulties in respect to all these points. The abstracts being illustrated in great part must have an instructional and stimulating effect upon anyone having the inventive faculty; and as they are published at only 1s. per volume I trust they will be largely consulted by all intending patentees. To those who can read drawings, and especially to members of our profession, they will prove very useful, for they will readily perceive the scope of these abstracts; but there is something more to be done for the information of those concerned with inventions, particularly for those more familiar with mechanism than with books—that is, to form an index museum of models representing inventions, which shall be as explanatory to the classification and abstracts as the drawings are to the specifications. Professional men are apt to place too high a value upon works for general reference, forgetting that others are not so well qualified to use them as themselves. Even to experts, an index museum of inventions at the Patent Office, and not at South Kensington, would be found most useful, especially in cases where the self-destructive element of growth comes into play. An illustration will, perhaps, make this more convincing.

Suppose an inventor designs a cable stopper to control the cable in lowering anchor on board ship, and desires to consult the abstracts which are available. He employs three principal elements:—(1) A U-shaped trough; (2) a chain cable passing through it; and (3) some device of a gripping character intended to jam the cable in the trough or to impede its motion through it. He finds the subject properly indexed under 113, Division 1, which includes ships, boats and rafts, and also, perhaps, under Class 24, chains, chain cables, &c., and would probably rest here, not finding an anticipation. But his device might be applicable to paying out wire rope cables, and he should, therefore, look under Class 40, embracing electric telegraphs and telephones, as covering submarine cables. This same device might be used in lifting, hauling and loading, Class 78; or in Class 109, ropes and cords, or if reduced in size it could be used for window blind cords; or in Classes 43, 44, and 141, which refer to fastenings—the former and the latter including articles of dress; or Class 141 for wearing apparel; while by slight modifications, it would apply to cable traction and tramway vehicles in Class 103, and to an arc lamp carbon holder in Class 39. Thus, by almost imperceptible variations in details, it becomes a device for feeding material to some point at which action is taken upon it, and this would lead us into a large number of the remaining classes.

Now, if we had an index museum of models at the Patent Office, in which devices performing similar functions were placed together, and references on them to their respective classes, it will be seen how easily inventors could follow the line of development, and perceive the applicability of particular forms of mechanism to new purposes. Of course only a small proportion of the typical forms would be required for each class, the examples being chosen to show the direction of growth, and as far as possible the mode of manufacturing the invention itself. In this way not only would the index museum form a valuable aid and adjunct to the classification and abstracts, but it would also prove, I believe, the pioneer of special technical museums throughout the country, exemplifying the industries of the several districts. Possibly, with the consent of the Treasury, the Board of Trade have power already to set up such a museum as an aid to the work of the Patent Office, but public opinion in its favour must be shown to exist before the Board can take the initiative. The new extensions of the Patent Office afford an excellent opportunity of establishing such an index museum, as I showed in letters to the press last December and January, and the suggestion has already met with a fair amount of approval.

An ideal classification is one in which the elements composing an invention can be referred to in one particular class, that class containing all former combinations of the same or similar elements, performing the same general function. From this it would follow that no anticipation could be found in any other class, but—as I have endeavoured to show—the growth of invention speedily breaks down all artificial barriers between the several classes. But if, by a reform in the law and procedure, the Patent Office were to assign an invention to one or more special classes, and the patentee allowed to restrict his invention to the same, or even to a special sub-division of a particular class, it would relieve him from much of the danger involving patents. Further, the law should define what is meant by "a new manufacture," and if it should enact that a new manufacture is one that has not been worked or freshly published during the last 25 years, it would probably lead to a revival of many industries which of late years have being leaving our shores, owing to strikes and foreign competition. I put the period at 25 years, to give an opportunity of taking evidence from men formerly engaged in such industries, while their memory is dependable; and, surely, the revival of old industries would be worth the gift of such a restricted monopoly as I have suggested in relation to the classification of patents?

THE MANAGEMENT OF BOILERS AND STEAM PLANT, INCLUDING DETAILS OF STEAM PIPES AND FITTINGS.*

By A. B. MOUNTAIN, Borough Electrical Engineer, Huddersfield.

During the last few years many exceedingly interesting papers have been read before learned societies upon steam generating appliances. These papers have, however, in most cases conveyed the manufacturer's experience of his own plant. It is, therefore, the author's

* Northern Society of Electrical Engineers, December 13th, 1897.

intention to place before the society his experience with various types of steam generators.

The idea which animates each individual when experimenting with a new form of steam boiler is, if possible, to utilise more of the heat generated by the fuel consumed. When it is considered that only about 50 per cent. of the units of heat in the fuel are utilised, it may be said that the best results obtained are far from those which may reasonably be expected. It is not necessary to discuss the ancient form of steam boilers when pressure of 40 or 50 lbs. per square inch were in use. It may certainly be taken that no modern works would be constructed in which the steam pressure would be less than 120 lbs. per square inch; in most cases it would no doubt be from 150 to 200 lbs. per square inch.

The class of load upon the boiler in a very large measure affects the design. If the works to be constructed will require about the same quantity of steam for a considerable number of consecutive hours, then the heat expended in raising a large body of water to the desired temperature is not such an important matter as it would be if the steam was required for a short time only, as is the case in an electricity works, where the load varies to an extent perhaps unknown to all but those connected with dye works, and in this case the boilers are under full steam for about 10 hours per day at regular stated times, and although the quantity of steam required varies considerably, it is usual to signal when a demand is needed, whereas in an electricity works the supply of steam depends upon the demand for energy which is delivered to consumers at a considerable distance from the works, who are quite unable to control the use of their lights, as atmospheric conditions vary so rapidly. It is often necessary, owing to a thunderstorm, or sudden fog, to require 20 times the quantity of steam in a very few minutes; this unusual demand must therefore be considered when selecting the type of boiler. Unfortunately, an engineer, when considering what type of boiler to adopt, is forced to look very carefully at the commercial side of the question. He must obtain a boiler which will evaporate the largest quantity of water with the smallest quantity of fuel, and he must not forget that the boiler must evaporate the largest quantity of water per pound of capital invested, and this should be considered in its widest sense; not only the actual cost of the boilers, but the additional cost of buildings, value of extra ground, &c., should be added, so that the true commercial value may be ascertained.

The question of maintenance is closely connected with the commercial consideration. One of the most important points, and one which influences the commercial side of the question very largely, is the failure of the boiler from any defects. This not only causes loss due to the cost of repairs, but necessitates holding in reserve another boiler, as the electricity supply cannot be stopped in the same way work of another kind might be; and the length of time required for cleaning is another point which seriously affects the cost of maintenance.

The next question is, what kind of water is to be used, it being assumed that the engines to be used are condensing, and that surface condensers will be employed, the water being fed to the boilers from the hot well. There are three sources of supply usually: the corporation town supply, the canal, and possibly a river or stream. The town supply is clean but expensive; the canal water is, as a rule, cheap, fairly clean, and is, in fact, usually rain water collected, and therefore very suitable. The river, supposing one to exist, if situated in Yorkshire or Lancashire, would not of necessity be clean, and it would be necessary to construct a pond, which would require a large capital outlay. Having carefully considered the subject, imagine the canal water was found most suitable and used for condensing purposes, and for making up the small quantity of feed water required to replace that lost. It would be clear that the water used being condensed would be soft and suitable for any form of boiler which might be adopted.

The next consideration would be the cost of boilers and space to be occupied, and imagine tenders were obtained for the boilers with fittings. The table shows approximately the particulars and prices for each type.

From the figures it will be observed that the water tube type is the lowest in price, and it has the great advantage of being a steam generator which may without detriment be forced far beyond its usual limit, and without, to any great extent, reducing its efficiency. It is particularly safe, and specially suitable for employment where high steam pressure is required. It will be noticed that the evaporation per pound of coal is high, and from tests made by the author he has seen these figures obtained repeatedly, but the boiler must be kept thoroughly clean, and it is surprising how quickly the evaporative power of the boiler decreases if the cleaning is not carefully done. The fact that the water and steam space is small is a point both for and against the boiler. It requires less fuel to heat up a small amount of water than a larger quantity would require, and there is practically no limit to the speed with which steam can be raised should another boiler be suddenly needed, but it necessitates careful attention to keep the steam pressure constant. One strong point in favour of the water tube boiler is its very perfect circulation, which means that practically all the water in the boiler is at very nearly the same temperature. Further, in case of failure in the supply of feed water, it is possible to run for a considerable time without doing any serious damage, as the active tubes are directly over the fire and are at the base of the boiler.

The dry back marine, or economiser type of boiler, occupies very small space, practically no setting, and is being used in several electricity works with very good results. It cannot be so rapidly forced as the water tube type, and a longer time must be allowed for getting up steam, as the circulation is not so good. Like the water tube boiler it must be kept very clean if really good results are to be obtained. It is not so easy to clean or inspect the interior as either the water tube or Lancashire type, and, in the author's opinion, is not so safe.

The marine boiler is being used in some electricity works, and has the advantage of requiring very little setting, occupies small space, and is a rapid steam raiser. It is, however, a type of boiler which requires considerable attention, cleaning, and repairs.

The locomotive boiler is also being used in some electricity works. It requires practically no setting, occupies small space, and is a rapid steam raiser. Like the marine boiler, it must be most carefully cleaned, and the cost of maintenance is comparatively high.

The Lancashire boiler is used in about three-quarters of the electricity works at present constructed. It, however, occupies a considerable amount of floor space, requires an extensive brickwork setting, and is not very efficient. It is usual, however, to combine with the Lancashire boiler some form of economiser for utilising the heat of the gases after they have left the flues of the boiler. The addition of the economiser considerably increases the cost of the boiler, and practically makes it the most expensive type to adopt, but it undoubtedly has many advantages. It has a large water and steam space; it requires less attention than any other form of boiler, and can be easily inspected and cleaned. One of its chief disadvantages is the length of time required to raise steam; although this can be done within two hours, it is usual to allow fully five hours, so that the boiler may be gradually warmed up. Another point against this type of boiler is its bad circulation. It may be practically cold at the bottom for hours after steam has been raised. Further, should the feed water be stopped from any accidental cause, great care must

Type of boiler.	Floor space occupied feet.	Water capacity in lbs.	Steam capacity in cubic feet.	Economiser evaporation. From	To	Pounds of water evaporated from and at 212° F. per lb. of coal consumed.	Heating surface feet.	Temperature of gases leaving boiler when working economically.	Price per boiler, including setting and fitting without mechanical stokers.	Cost of buildings and ground at £2 per foot.	Price in £ per 100 lbs. of water economically evaporated.
Water tube ...	180	17,500	200	6,500	9,000	11·5	1,827	350	565	360	14·2
Lancashire ...	360	43,000	200	6,500	7,500	10 0	1,050	600	575	720	19·7
Lancashire with economiser.	410	76,000	260	6,500	9,000	12 0	1,770	250	725	820	23·3
Locomotive ...	150	22,000	200	6,500	7,500	11·0	1,500	600	675	300	15·0
Dry back marine	160	25,000	220	6,500	7,500	11·0	1,650	600	645	320	14·5
Marine	150	17,000	180	6,500	7,500	11·0	1,500	600	675	300	15

It is impossible to consider the type of boiler most suitable for any works, without most carefully investigating the water it is proposed to use, and the ultimate effect of this upon the boiler. As an example, assume that the water to be used has in solution a considerable quantity of lime. This would, when heated, throw the lime down in the form of a thick scale; and it would, therefore, be most unsuitable for feeding direct to a boiler of the water tube type, as it would be difficult to remove the scale, and it would, therefore, increase very considerably the cost of maintenance, and decrease the evaporative power of the boiler. It is, therefore, very desirable to have the water carefully analysed, and ascertain as nearly as possible its effects upon each type of boiler proposed to be employed.

For the purpose of comparison it will be advisable to assume some data. Therefore, take the case of an imaginary electricity works, for a small town requiring a sufficient quantity of steam ultimately to drive engines having a total of 5,000 indicated horse-power. Allowing 25 lbs. of steam per horse-power, the total evaporation of water would require to be at the rate of 125,000 lbs. per hour. It will now be necessary to decide how many boilers shall be used and the power of each. Therefore, it will be desirable to ascertain what quantity of steam would be required during the daytime, and taking other towns as an example, it would be safe to estimate that the day load during the summer months would not exceed 200 indicated horse-power, or 5,000 lbs. of water per hour. It is clear, therefore, that the boilers must be divided so that one can run this small load efficiently; and 6,500 lbs. may therefore be taken as about the evaporation which would be required from each boiler.

be taken that it does not fall below the top of the furnace, or the results may be very serious, as the furnace top would become heated, and possibly collapse.

Having regard to the varying demand for steam in an electricity works, the author is of opinion that the water tube is the type of boiler specially suitable for adoption at the commencement of an undertaking, and that as the load upon the works increases, Lancashire boilers with economisers should be added, so that the continuous load may be supplied from them, and the water tube boilers forced during the period of heavy load. In this way it is possible to reduce the number of boilers employed, and consequently make a considerable reduction in the capital outlay.

It would, however, be extremely unprofitable to employ Lancashire boilers without utilising in some manner the heat of the gases leaving the flues. Several methods have been devised for utilising this heat. It may be employed for superheating the steam, for heating the feed water, or the gases may be passed through another fire. If it is desired to heat the steam, a large number of small tubes are usually arranged at the back of the boiler, through which the hot gases have to pass. The amount of superheating required is regulated by the number of tubes attached to each boiler.

The economiser or feed water heater usually adopted consists of a large number of pipes fixed in the main flue, the cold water being fed into the bottom of the pipes, and passing from the top to the boiler. The hot gases, on their way to the chimney, passing through the tubes heat up the water to a very considerable extent. This apparatus has a further advantage—the water in passing very slowly through the tubes becomes heated, leaving a considerable amount of deposit in the economiser, which would otherwise find its way into the boilers. Many different arrangements have been carried out, but it is advisable, in the author's opinion, to arrange for the gases to pass the tubes as much as possible in parallel and not in series. As an example, the temperature of the gases in the main flue at the back of a Lancashire boiler, when working under economical conditions, is at about 600° Fahr., and after passing through an economiser, consisting, say, of 36 tubes in length and 8 in width, would be about 250° Fahr. If it was necessary to reduce the number of tubes, it would be much better to decrease the length of 36 tubes to 18 than the width of 8 to 4, as in practice it is found that the first few rows upon which the heated gases impinge are doing the bulk of the work, and that the tubes nearest the chimney are doing very little.

(To be continued.)

NEW PATENTS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co. *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

28,746. "A simplified automatic generator for supplying the electric light for cycles and other vehicles." W. Doherty. Dated December 6th.

28,751. "Improvements in or relating to electric bells." C. Turnbull, jun. Dated December 6th.

28,765. "Electric fire alarm." H. Patchett. Dated December 6th.

28,784. "An electrical apparatus for communicating between railway carriages and the guards van or engine." E. P. Dix. Dated December 6th.

28,795. "A new or improved compound material for electrical insulating purposes." H. J. Brown, O. R. H. Schmidt, and A. Mackenzie. Dated December 6th.

28,799. "Improvements in electric current meters." P. Eibig. Dated December 6th. (*Complete.*)

28,800. "Improved electric meter. "A. Peloux. Dated December 6th.

28,809. "Improvements in or relating to electric arc lamps." C. Oliver. Dated December 6th.

28,823. "Improvements in covers, caps, and lids of gas, sewer, telephone, and electrical supply shafts and holes, gulleys, and the like." J. Price and J. Johnson. Dated December 6th.

28,839. "Improvements in trolleys used on overhead wires for electric traction." W. Wood. Dated December 7th.

28,853. "Improvements in electrical magazine fuse blocks." W. G. Heys. (W. Ehrhardt, W. B. Thom, and G. A. Connor, United States.) Dated December 7th. (*Complete.*)

28,859. "Improvements in resistance and contact apparatus for electric currents." H. Lyon. Dated December 7th.

28,882. "Improvements in electrical valve controlling devices." G. Barker. (G. J. Schoeffel, United States.) Dated December 7th. (*Complete.*)

28,883. "Improvements in mechanical movements and in mechanism of arc lamps for automatic feeding of the carbons as required by their consumption." H. M Baker, jun., and A. W. Fox. Dated December 7th (*Complete.*)

28,895. "Improvements in insulating supports for the third rail or electric conductor of electric railways." A. Anderson. Dated December 7th. (*Complete.*)

28,921. "Improvements in transformers and apparatus connected therewith for alternating current systems of electrical distribution." E. Oxley. Dated December 7th. (*Complete.*)

28,923. "Improvements in means for electrically controlling the opening and closing of a plurality of escape orifices for fluids." F. V. Beauvois. Dated December 7th.

28,926. "An improved electric switch." F. A. Gilbert. Dated December 7th. (*Complete.*)

28,932. "An arrangement of electric motor for the propulsion of vehicles." P. J. M. Gassier. Dated December 7th.

28,935. "Improved means for climbing telegraph posts and for like purposes." G. H. Robisson and H. W. Cash. Dated December 7th.

28,940. "Improvements in magnetic telegraphy." O. J. Lodge. Dated December 7th.

28,943. "Improvements in or connected with electric driving gear." E. Corbens and the firm of C. Wilh, Kayser, & Co. Dated December 7th. (*Complete.*)

28,952. "Improvements in insulated electric conductors and apparatus for making the same." J. D. Bishop. Dated December 7th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, June 7th, being date of application in the United States.)

28,956. "Improvements in electric cables." J. H. Kelman. Dated December 7th. (*Complete.*)

28,960. "Improvements in pushes for electric bells and the like." I. H. Parsons, A. W. Staveley, and I. H. Parsons, trading as Gent & Co. Dated December 7th.

28,965. "Improvements in controllers for motors and brakes of electric cars." A. Grossman. Dated December 7th. (*Complete.*)

28,994. "Regulating electric motors for working hoists or the like." W. H. Scott. Dated December 8th.

29,009. "Improvements in or relating to electric furnaces for the production of calcium carbide and other substances." J. Bastick and W. A. Thornton. Dated December 8th.

29,010. "Improvements in or relating to means or apparatus for conveying the boxes to and from electrical furnaces." J. Bastick and W. A. Thornton. Dated December 8th.

29,011. "Improvements in or relating to electric furnaces for the production of calcium carbide and other substances." J. Bastick and W. A. Thornton. Dated December 8th.

29,024. "Improvements in electric lighting." J. Webster and W. Reynolds, Jun. December 8th. (*Complete.*)

20,055. "Improvements in or relating to alternate current meters." C. P. Feldman and Helios Elektricitats-Aktiengesellschaft. Dated December 8th.

29,069. "Improvements in syntonic telegraphy." O. J. Lodge and A. Muirhead. Dated December 8th.

29,090. "New process or system of sewage and foul water purification by electrical action." A. B. Ogden. Dated December 9th.

29,116. "Improvements in the distribution and regulation of electric energy and in conductors connected therewith." S. W. Baynes. Dated December 9th.

29,155. "Improvements in electric lampholders." E. L. Joseph. Dated December 9th. (*Complete.*)

29,177. "Improvements in and connected with underground electric conduits." J. Atherton. Dated December 9th.

29,180. "An improved electrical accumulator." P. Brandt. Dated December 9th. (*Complete.*)

29,222. "An improved terminal for use in electric switches, cut-outs, ceiling roses, wall plugs and the like accessories." S. E. Foster. Dated December 10th.

29,235. "Improvements in electrical switches." J. Moores and H. O. Farrell. Dated December 10th.

29,244. "Improvements in apparatus for freeing, lighting and extinguishing gas burners at a distance by means of electricity." P. Guyenot. Dated December 10th. (*Complete.*)

29,257. "Improvements in or relating to electric signalling, particularly on railways." W. S. Boult and C. R. Boult. Dated December 10th.

29,273. "Improvements in plates or electrodes for electric accumulators." H. H. Lake. Dated December 10th.

29,318. "Improvements in and connected with the control and regulation of electrically propelled vehicles." E. J. Wade and The Electric Motive Power Company, Limited. Dated December 11th.

29,322. "An improved method of exhausting incandescent electric lamps, and apparatus to be used therefor, and for similar purposes." H. S. Maxim. Dated December 11th.

29,328. "Improvements applicable to hoists worked by means of electricity." C. Hamilton. Dated December 11th.

29,347. "An electrical slide changing apparatus and dissolver for optical lanterns." A. Elsee and H. S. Pyne. Dated December 11th.

29,361. "Improvements in or relating to electric gas lighting and controlling devices." J. H. Kebridge. Dated December 11th.

29,390. "Improvements in electrical apparatus for transmitting and receiving predetermined messages." Siemens Brothers & Co., Limited, and C. Holden. Dated December 11th.